

# PROGRESSIVE CULTIVATION FACTS FOR FARMERS



**HERCULES**



**POWDER**

**HERCULES POWDER CO.**

**Wilmington, Delaware, U. S. A.**



HERCULES

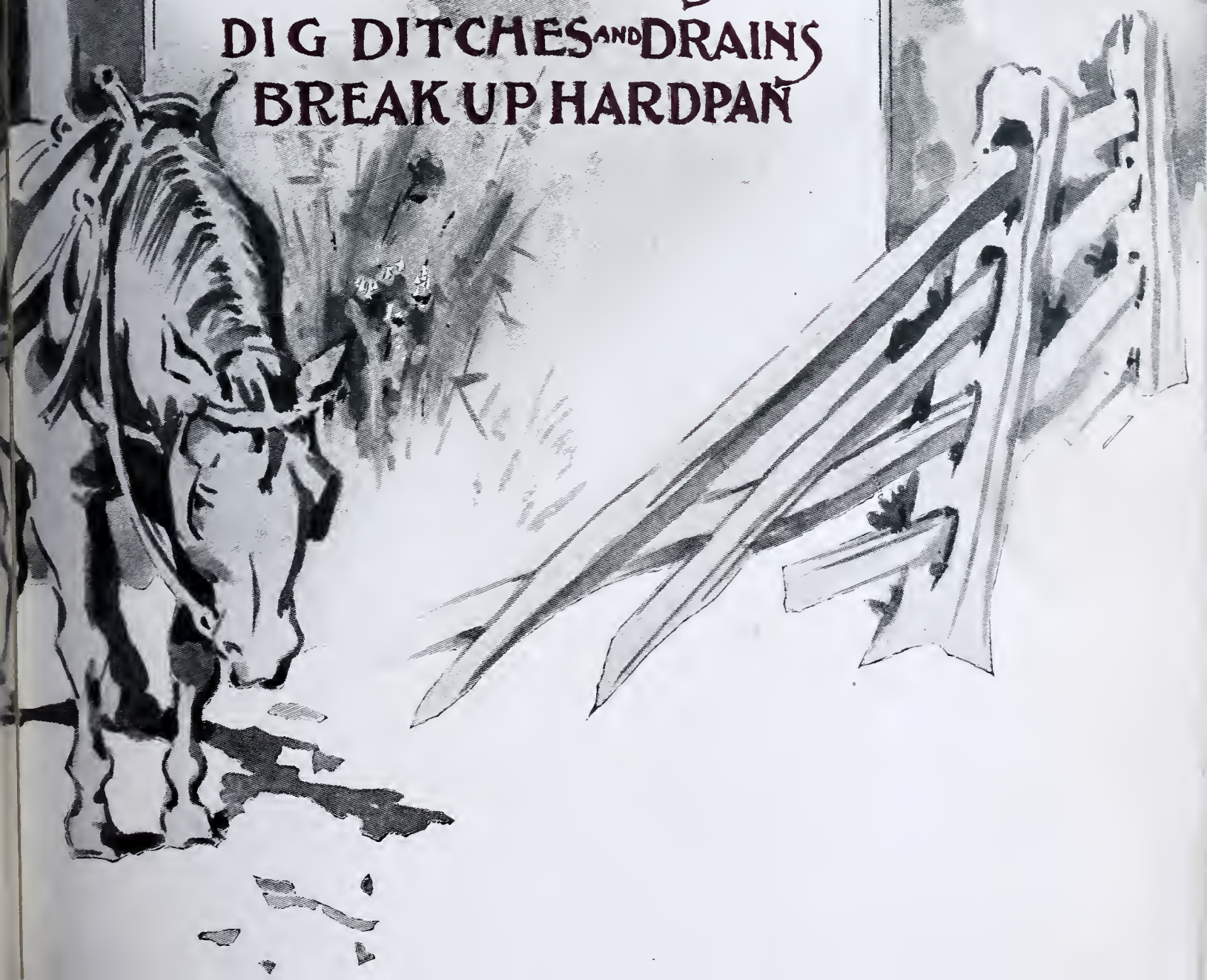


POWDER

# PROGRESSIVE CULTIVATION

FACTS *for* FARMERS

HOW  
TO CLEAR LANDS OF  
STUMPS AND BOULDERS  
PLANT TREES  
DIG DITCHES AND DRAINS  
BREAK UP HARDPAN



Copyright, 1913

***HERCULES POWDER CO.***

Wilmington, Delaware

# INDEX

Air in the Soil.....	61	Digging Holes for Posts or Poles...	77
Alkali Soils, Reclamation of.....	57	Digging Wells.....	75
Auger, Dirt.....	31	Dirt Auger.....	31
Auger, Wood.....	30	Disposal of Stump.....	46
Bacteria in the Soil.....	63	Ditch Blast, Propagated.....	49
Batteries.....	11	Ditches Blasted to Connect Streams.	54
Benefit from Planting Trees with Dynamite.....	72	Ditching, Method of.....	47
Benefits from Subsoil Blasting.....	68	Ditching with Blasting Machines...	51
Bigtree Stumps.....	41	Ditching, Methods of Connecting up Electric Circuits.....	54
Blasting Caps.....	9	"Doby Shooting".....	35
Blasting, Boulder.....	33	Draining Ponds.....	55
Blasting Hardpan.....	59	Draining Swamps.....	55
Blasting Machines.....	11	Duplex Leading Wire.....	13
Blasting Powder.....	8	Dynamite.....	5
Blasting, Subsoil.....	67	Dynamite, Extra Low Freezing.....	7
Blasting Supplies.....	9	Electric Blast, Method of Connecting	26
Blasting, Stumps.....	37	Electric Fuzes.....	10
Blasting Tight Subsoil.....	59	Electric Squibs.....	11
"Blistering".....	35	Erosion, Controlling of.....	76
Block Holes.....	33	Excavating Cellars.....	75
Boulder Blasting.....	33	Excavating Foundations.....	75
Boulder Blasting, Comparison of Methods of.....	36	Explanatory.....	3
"Bulldozing".....	35	Explosives.....	5
Caps, Blasting.....	9	Extra Low Freezing Dynamite.....	7
Cap Crimpers.....	14	E. L. F. Dynamite.....	7
Capillary Storage of Moisture.....	62	Farm Blasting, Tools Needed for..	29
Capillary Movement of Moisture...	62	Felling Trees.....	45
Cedar Stumps, Western.....	41	Filling Gullies.....	76
Cellars, Excavating.....	75	Fir Stumps, Western.....	41
Clearing Lands, Rules for.....	45	Foundations, Excavating.....	75
Comparison of Methods of Boulder Blasting.....	36	Fuse.....	9
Connecting Streams by Blasting Ditches.....	54	Fuzes, Electric.....	10
Connecting Electric Blast.....	26	Galvanometers.....	14
Connecting Wire.....	13	Gully Filling.....	76
Controlling Erosion.....	76	Handling, Rules for.....	78
Crimpers.....	14	Handling Dynamite.....	17
		Hardpan, Blasting.....	59
		Hardpan Restricting Drainage.....	61
		Hauling Dynamite.....	17

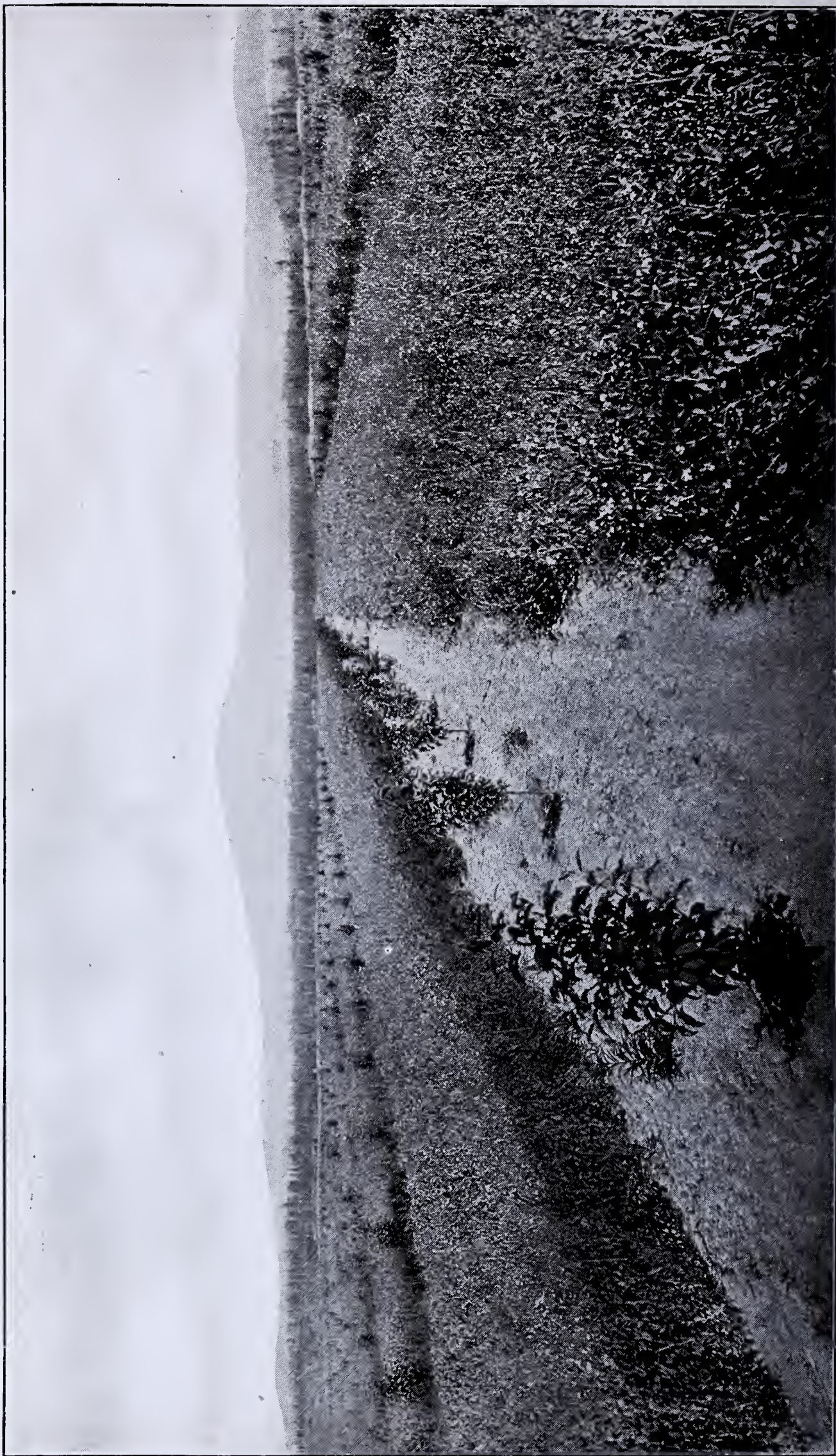
## INDEX—Continued

Hauling Blasting Supplies.....	17	Rules for Handling Dynamite.....	18
Hercules R. R. P.....	7	Small Fibrous Rooted Stumps, Blast-	
Importance of Water in Crop Pro-		ing.....	39
duction.....	59	Snakeholes.....	34
Kettles, Thawing.....	15	Soil Bacteria.....	63
Large Fibrous Rooted Stumps, Blast-		Splitting Logs.....	76
ing.....	40	Squibs, Electric.....	11
Leading Wire.....	13	Storing Dynamite.....	17
Loading Holes.....	25	Storage of Moisture, Capillary.....	62
Logs, Splitting.....	76	Stump Blasting.....	37
Movement of Moisture, Capillary ..	62	Stumping in the Orchard.....	45
Mudcapping.....	35	Subsoil Bar.....	29
Opening Dynamite Cases.....	17	Subsoil Blasting.....	67
Orchard, Stumping in the.....	45	Subsoil Blasting, Benefits of.....	68
Orchards, Rejuvenation of.....	73	Subsoil Blasting, Cautions to be Ob-	
Pine Stumps, Western.....	41	served.....	69
Plant Food.....	63	Subsoiling, Amount of Material	
Plant Roots.....	62	Needed to Blast an Acre.....	67
Planting Trees.....	70	Swamps, Draining.....	55
Planting Trees with Dynamite, Bene-		Tamping.....	25
fits from.....	72	Tamping Stick.....	31
Ponds, Draining.....	55	Taprooted Stumps, Blasting.....	37
Post Hole Digging.....	77	Thawing Dynamite.....	19
Powder, Blasting.....	8	Thawing Houses.....	20
Powder, Hercules.....	6	Thawing Kettles.....	15
Priming Cartridges.....	21	Tight Subsoil, Blasting.....	59
Priming with Blasting Cap and Fuse	21	Tools Needed for Farm Blasting....	29
Priming with Electric Fuze.....	23	Tree Planting.....	70
Probe.....	31	Undesirable Soil Conditions, Relief	
Propagated Ditch Blast.....	49	of.....	65
Punch.....	31	U. S. Standard Blasting Machines..	11
Punch Bar.....	29	Water in Crop Production, Impor-	
Reclamation of Alkali Soils.....	57	tance of.....	59
Redwood Stumps.....	41	Wells, Digging.....	75
Relief of Undesirable Soil Conditions	65	Western Cedar Stumps.....	41
Rejuvenation of Orchards.....	73	Western Fir Stumps.....	41
Rheostats.....	14	Western Pine Stumps.....	41
Road Building.....	74	Wire, Connecting.....	13
R. R. P. (Hercules).....	7	Wire, Duplex Leading.....	13
Rules for Clearing Land.....	45	Wire, Leading.....	13

## EXPLANATORY

THE great demands that have of late years been made on the farmer, have forced him to abandon many of his old customs, practices and methods, and to adopt those that will enable him to keep pace with the rapid progress made along other lines. The great advantages derived from the economic use of explosives, their assistance as time and money savers, and their effectiveness in increasing the productiveness of field and orchard crops, are attracting much attention. Thousands of tons of dynamite are used annually for clearing land, digging ditches, draining low wet spots, planting trees, and shattering hardpan and other impervious subsoils.

This handbook is prepared to answer some of the questions that will arise in the minds of those who are novices in the use of dynamite.



# FACTS FOR FARMERS

## EXPLOSIVES

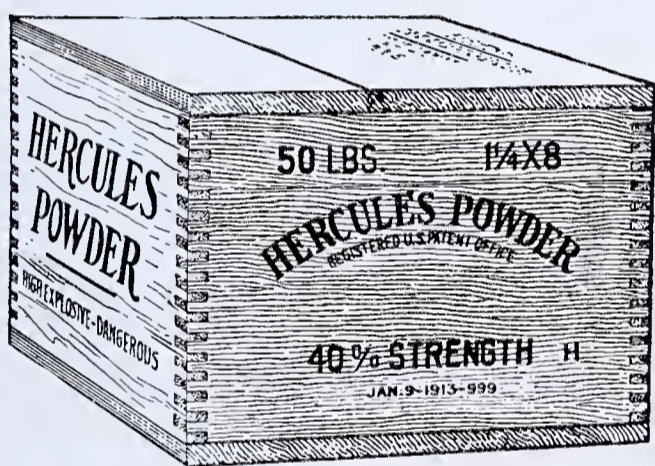
While railroading, mining, quarrying and other kindred operations require a large number of different kinds and strengths of dynamite and other explosives, the grades needed by the farmer are very few, even if he has to undertake some work along all the lines for which explosives are required.

## DYNAMITE

The chief explosive used on the farm is dynamite. The many stories in regard to the dangers of handling and using nitroglycerin, some of which is incorporated in all standard dynamite, have led those contemplating its use to consider it far more dangerous than it really is. Gasoline, steam boilers and electric dynamos must be handled with care, and so must dynamite; but when the proper precautions, which are clearly set forth in the following pages, are followed, there is no more danger in blasting than in following many of the ordinary vocations of life, such as railroading, working in mills or foundries, riding on trains, etc.

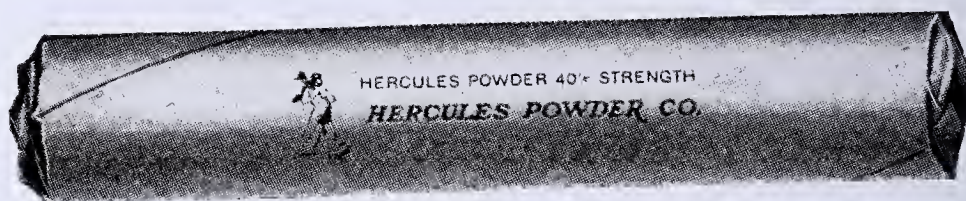
In making Hercules dynamite the nitroglycerin is so compounded with fine wood pulp and other material, that the sensitive nitroglycerin is robbed of much of its dangerous quality. When the process of manufacture is completed, the product closely resembles slightly damp and very fine sawdust. It is then packed into cylindrical shells of tough paraffined paper known as cartridges. The standard size of a cartridge is  $1\frac{1}{4}$  inches in diameter and 7 inches in length. This weighs about one-half a pound, and there are 50 pounds, net weight, of dynamite packed in a shipping case.

The strength of dynamite is based on the explosive force of pure nitroglycerin and is always expressed in percentage. For agri-



BOX OF HERCULES DYNAMITE

cultural work the strength varies from 25% to 60%. Dynamite is made in lower strengths, but the Hercules Powder Company recommends the use of nothing weaker than 25% for agricultural work. The above differences in strength are obtained by varying



A DYNAMITE CARTRIDGE, 40% STRENGTH

the proportions of the ingredients in its manufacture. Other modifications are made in dynamites, one of the principal of which is the compounding which reduces the temperature at which certain Hercules dynamites are frozen. Ordinary dynamites freeze at a temperature of between 45° and 50° F., but the Hercules Extra Low Freezing (E. L. F.) grades do not freeze until after a temperature has been reached at which water freezes. This greatly enhances their value for work where cold weather conditions are encountered.

The enormous force of "Hercules Powder" is produced by its being converted instantaneously into gases, the volume of which is many times greater than the volume of the original dynamite. This expanding gas exerts pressure in all directions, just as the steam from hot water in a boiler exerts pressure on the walls that confine it. The pressure that may be exerted by the expanding gases is many times greater than the pressure in the strongest steam boilers. Unlike the burning of wood or coal, which give off large quantities of gas slowly, dynamite is converted into gas instantaneously. This changing into gas is spoken of as "detonating," and should not be confused with the slower changing of Blasting Powder into gas, which process is known as "exploding."

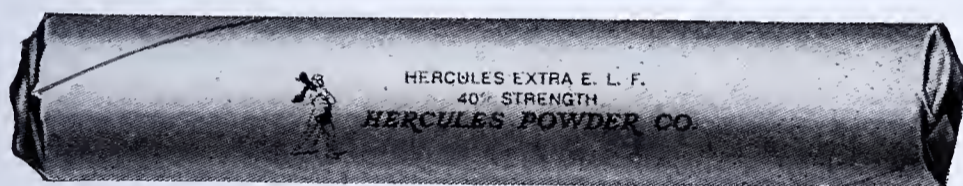
While all dynamites can be considered, so far as all practical purposes are concerned, as detonating instantaneously, there is a marked difference in them in this respect. The higher strengths of any grade detonate more rapidly and have more of a smashing action than do the lower strengths. When a powerful, quick blow is desired, as in breaking hard rock, the stronger and quicker grades are used, but for shattering hardpan or blasting holes for tree-planting, where the desire is to break fissures for a considerable distance through moderately hard and less resistant material, the weaker and slower grades give the best results. These differences must be borne in mind as they will be referred to later on.

Wood or oil is ignited or started to burn by a flame or by a very hot substance. Black Powders are exploded by a spark or flame, but Hercules Powder (dynamite) is detonated by a violent shock, such as is produced by the explosion of a Hercules blasting cap or electric fuze. Dynamite may burn without exploding, but when heated is quite sensitive to shock and cannot be handled or approached without danger.

The different grades and strengths of dynamite which are used on the farm for stump blasting, boulder blasting, ditching, hardpan blasting, tree-planting, drainage, and for other purposes, will be discussed later.

## HERCULES E. L. F. DYNAMITE

The Hercules Powder Company manufactures a special brand of explosives for agricultural work. This is known as Hercules E. L. F. Dynamite and is made in all strengths from 25% to 60%. The weaker grades have an excellent heaving action, while the stronger ones have a good smashing effect. Ordinary



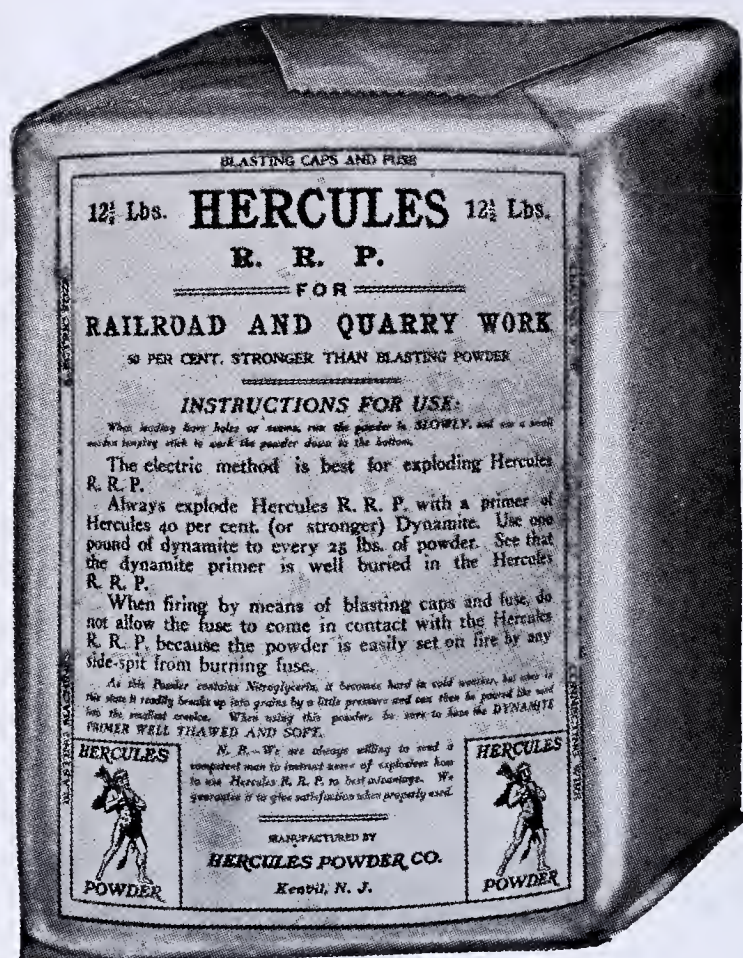
dynamite, as stated above, freezes at temperatures between 45° and 50° F., while the Hercules E. L. F. Brand, as also stated previously, does not freeze until after water freezes.

This makes Hercules E. L. F. Dynamite an excellent explosive to use in the spring and fall months, because it will not freeze during the cool nights like the ordinary brands of dynamite. The "Extra Grades" of Hercules E. L. F. Dynamite are as safe to handle and use as it is possible to make dynamite. They are only set on fire with the greatest difficulty, being practically immune from ignition by the side spit of fuse. In short, Hercules E. L. F. Extra Dynamite is the ideal explosive to use on the farm.

## HERCULES R. R. P.

Hercules R. R. P. is a granular explosive powder much stronger than blasting powder, and is put up in paraffined paper bags containing 12½ pounds avoirdupois of explosive. Four of these bags are packed in each case. This powder will freeze and become

lumpy at 45° or 50° F., but thawing is unnecessary if the lumps are crumbled before loading. It must be detonated with a primer of Hercules Dynamite not weaker than 40% strength, using one pound of dynamite to every 25 pounds of the R. R. P. The Hercules R. R. P. grade is extensively used for blasting redwood or



BAG OF HERCULES R. R. P.



KEG OF HERCULES BLASTING POWDER

bigtree stumps. Hercules Powder also is manufactured in three other grades similar to but stronger than Hercules R. R. P., and these grades are Hercules Powder F, FF and FFF, running from the weaker to the stronger grades. These grades (F, FF and FFF) can be detonated by a Hercules No. 6 (or stronger) blasting cap or electric fuze.

These three grades are packed in cartridges similar to dynamite, and are sometimes used for blasting stumps. Hercules R. R. P., F, FF, and FFF are only used in agricultural work for blasting stumps.

## HERCULES BLASTING POWDER

This is a granular black powder. It is made in different sizes of grains and is packed in metal kegs containing 25 pounds avoirdupois. Hercules blasting powder is used on the farm only for splitting logs.

# HERCULES BLASTING SUPPLIES

For different classes of work, different supplies are needed, such as Hercules blasting caps, Hercules electric fuzes, fuse, United States Standard blasting machines, and a few other articles mentioned later. These are generally referred to as "blasting supplies."

## HERCULES BLASTING CAPS

A blasting cap differs from the primer in a shotgun or rifle cartridge only in being larger and more powerful. It is used to detonate dynamite as the primer just mentioned is used to explode the gunpowder in rifle or shotgun cartridges. Several strengths or sizes of Hercules blasting caps are manufactured, and the strength of the cap is expressed by its number—No. 6, No. 7, No. 8, etc.—the strength increasing with the number.

Nothing weaker than a Hercules No. 6 blasting cap should be used for detonating any of the Hercules Dynamites used on the farm. The Hercules No. 6 cap is a copper cylinder about  $1\frac{3}{8}$  inches long and slightly less than  $\frac{1}{2}$ -inch in diameter; it is closed at one end and loaded with a small amount of a quick-acting explosive, which is fired by a spark from the fuse. Hercules blasting caps are packed in tin boxes each containing 100 caps.



BOX OF BLASTING CAPS



HERCULES  
No. 6  
BLASTING  
CAP

## FUSE

Fuse is a small train or core of powder wrapped in a covering of thread or tape, which is coated with some substance that makes it more or less waterproof. It is used in connection with Hercules blasting caps to detonate single charges of dynamite, or by itself to explode small charges of black powder. While fuse is manufactured in all grades, from cheap to very expensive, the brands of fuse recommended for use in agricultural work are, for the Eastern States, the Crescent



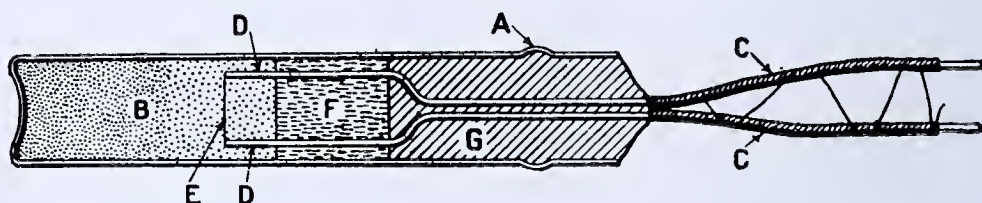
COIL OF FUSE

Brand or its equivalent, and for the Western States, the Comet Brand or its equivalent. These have a cord winding and are superior to the tape fuses on account of their greater flexibility, particularly in cold weather. The cord-wound fuses do not break as readily when bent sharply as do the tape-wrapped ones.

Fuse is put up in double coils containing 100 feet, and the standard packages for shipment contain from 500 to 12,000 feet of fuse. The burning rate of fuse varies considerably, but averages about 2 feet per minute. A sufficient length should always be used to permit the blaster being at a safe distance from the blast.

## HERCULES ELECTRIC FUZES

Hercules electric fuzes are blasting caps in which the charge is detonated by an electric current instead of by a spark from safety fuse. They are necessary when it is desired to fire two or more shots in unison, and are better than cap and fuse for detonating dynamite in very wet work or under water. The accompanying illustration shows in section an electric fuze.



"A" is the shell of copper having a corrugation thrown out from the inside, which holds the composition plug more firmly in place. "B" is the chamber containing the explosive charge. "C" is the insulated copper wires entering the cap, and "D" the bare ends of the copper wires projecting through the plug into the charge. "E" is the small platinum wire or bridge soldered to and connecting the two ends of the copper wires, which when heated by the electric current detonates the explosive charge in the copper shell. "F" is the composition plug holding the fuze wires firmly in place, and "G" is the filling material.

Hercules electric fuzes have two insulated copper wires sealed in the cap. The tips of these wires inside of the cap are bare and joined together by a platinum wire finer than a thread. When the electric current passes through the fuzes it makes the platinum wire hot enough to detonate the charge in the copper cap.

Hercules electric fuzes are packed in pasteboard cartons, which are enclosed in heavy wooden cases. Each carton contains either 25 or 50 fuzes, depending on the length of the wires. Hercules electric fuzes with wires from four feet to sixteen feet long are ordinarily packed for domestic shipment in cases containing 500, while those



HERCULES  
No. 6  
ELECTRIC  
FUZE

with longer wires are packed in cases containing only 250 each. Fuzes are made in different strengths, the strength being indicated by numbers as in blasting caps. Nothing weaker than a Hercules No. 6 electric fuze should be used for detonating any of the Hercules dynamites used on the farm.

## HERCULES ELECTRIC SQUIBS

Electric squibs are somewhat similar in appearance to fuzes but have a heavy paper shell instead of a copper one. The charge in this cap does not detonate like that in an electric fuze, but merely shoots out a small flame. They are used in agricultural work for exploding several charges of



HERCULES ELECTRIC SQUIB

blasting powder at the same time, as in splitting logs where it is desired to split them uniformly. Electric squibs are packed in paper cartons containing 50 each. There are ten cartons to a shipping case.

## UNITED STATES STANDARD BLASTING MACHINES

To generate the current for firing electric fuzes and squibs, blasting machines, sometimes called "batteries," are used. These machines are simply portable dynamos adapted for this work. United States Standard blasting machines are manufactured in five sizes. No. 1 will fire from 1 to 3 electric fuzes or squibs; No. 2, 1 to 10; No. 3, 1 to 30; No. 4, 1 to 50. Machines of greater capacity can be had on order. They are all manufactured in what is known as the "pushdown" type, and are operated by lifting the handle of the rack bar as far as possible, and then pushing it down with a steady, hard, quick blow. When the rack bar strikes the bottom the current of electricity passes through the wires and detonates the fuzes. It is always well to place the blasting machine on something firm, level and dry when operating it.

The United States Standard No. 1 and No. 2 blasting machines have two binding posts; the No. 3 size also has two posts unless specially ordered with three. The No. 4 is manufactured with three posts only. The "three-post" blasting machines will explode at one time 50 per cent. more electric fuzes than two-post machines

of the same size. The leading wires are connected with the blasting machine by pushing the well-scraped bare ends of the wires through the small holes in the binding posts and screwing the wing nuts down firmly upon them. When a three-post blasting machine is used with three leading wires, the wires from the two outside posts are connected with the first and last electric fuzes in the circuit, while the



U. S. STANDARD TWO-POST  
BLASTING MACHINE



U. S. STANDARD THREE-POST  
BLASTING MACHINE

one from the middle post is connected with the two middle electric fuzes in the circuit. A three-post United States Standard blasting machine may be used with two wires only by connecting these wires with the first and last electric fuzes in the circuit respectively, and with the middle and either one of the two outside binding posts—not with the two outside ones.

The United States Standard blasting machines are strongly made, and will stand with little deterioration the treatment to which it is often necessary to subject them. Their mechanism, though designed as simply as possible, is more or less complicated and delicate, and although they will, as stated above, withstand the usage to which it is often necessary to subject them, they should be treated with at least some consideration. There can be no possible excuse for throwing a blasting machine about, permitting it to remain exposed to wet weather or to leave it lying in the mud. When a blasting machine is treated in this manner its life will be short and its usefulness limited. If it is necessary to use them in wet weather or in wet work they should be carefully wiped

off before being put away. A blasting machine should not be put in a hot place to dry out if it has become wet, but after being wiped off it should be put in a cool, dry place until it has had time to dry out slowly. United States Standard blasting machines are guaranteed when properly handled to fire up to their rated capacity.

## HERCULES CONNECTING WIRE

Connecting wire is insulated copper wire (No. 20 Brown & Sharpe gauge), and is put up in one-pound and two-pound spools. A one-pound spool is three inches in diameter, four inches long and holds about 210 feet of wire. A two-pound spool is three inches in diameter, five and one-half inches long and holds about 420 feet of wire. Hercules connecting wire is used to join the wires of electric fuzes when they are not long enough to reach between the adjoining holes.



SPOOL OF CONNECTING WIRE

## HERCULES LEADING WIRE

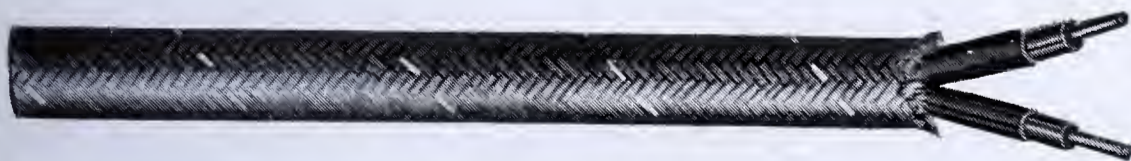
The wire commonly used for connecting electric fuzes to the blasting machine is known as leading wire. It is insulated copper wire (No. 14 Brown & Sharpe gauge) and is furnished in coils of the following lengths and weights:



COIL OF LEADING WIRE

- 200 ft. about 4 lbs.
- 250 ft. about 5 lbs.
- 300 ft. about 5.8 lbs.
- 500 ft. about 9.6 lbs.

“Duplex” leading wire is made by binding together two insulated copper wires with an outside insulation, giving it the effect



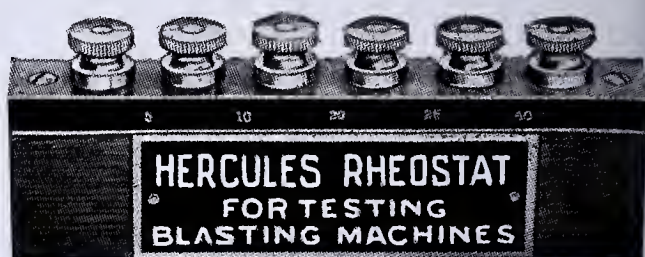
DUPLEX LEADING WIRE

of a single cable. It is somewhat higher in price, but generally more convenient than “single” leading wire. It weighs approximately twice as much as the same length of single leading wire and can be had in coils of the same length.

The leading wire furnished by the Hercules Powder Company is of high grade and will stand much usage and abuse.

## HERCULES GALVANOMETERS AND RHEOSTATS

For testing the efficiency of blasting machines a small rheostat is used. For examining electric circuits before blasting, the use of a Hercules galvanometer is highly recommended. Both of these instruments are light and inexpensive, and are very useful where much work is being done. Detailed information will gladly be furnished on request.

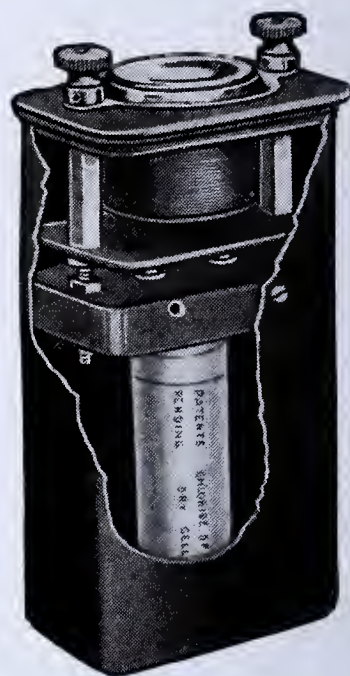


HERCULES RHEOSTAT



IN CASE

HERCULES GALVANOMETER



OUT OF CASE AND  
SECTIONALIZED TO  
SHOW THE IN-  
TERIOR

## HERCULES CAP CRIMPERS

For attaching caps to fuse a specially designed cap crimper is used. No blaster using caps and fuse should be without this tool, as it makes priming safer and easier. A cap attached to fuse with one of these cap crimpers cannot easily be pulled off. It also makes a much more water-proof joint than is possible by any other method.



HERCULES CAP CRIMPER

## THAWING KETTLES

High explosives containing nitroglycerin freeze and become insensitive in cold weather, and when frozen may burn instead of being detonated. The fumes from burning dynamite are very noxious and in "close" places, such as mines or tunnels, injury to health from them is often severe. It is obvious, therefore, that when dynamite that is liable to freeze is to be used in low temperatures, some provision *must* be made for *thawing* it and for *keeping it thawed* until it is loaded into the bore hole. As dynamite, the low freezing brands excepted, freezes at temperatures between 45° and 50° F., the thawing problem is a troublesome one. On work where these explosives are used in large quantities, thawing houses are absolutely necessary; but even then thawing kettles should be employed to take the explosives from the thawing house to the place where they are to be used, in order to prevent them from again becoming chilled or frozen.

These thawing kettles are all made with a watertight compartment for the explosives (dynamite should never under any circumstances be permitted to come in contact with hot water), and this compartment is surrounded by the receptacle for the hot water. The Catasauqua thawing kettles are in one piece, which makes them very convenient and durable. They are the best on the market.



CATASAUQUA THAWING  
KETTLE



COASTAL PLANTING GIVES THE ROOTS A CHANCE AND INCREASES THE SOIL'S CAPACITY FOR STORING WATER AND OTHER PLANT FOODS

# HAULING DYNAMITE AND BLASTING SUPPLIES

Dynamite, blasting powder, caps, fuzes, etc., are shipped by freight, and must be removed from the railway station within twenty-four hours after their receipt. In hauling dynamite the wagon should be swept clean of dirt and grit and the boxes laid flat on the bottom. If the vehicle is open, the explosives should be covered with a heavy cloth or tarpaulin to protect them from sparks, rain, etc. Never haul detonators (blasting caps and electric fuzes) and explosives together. Detonators are more sensitive and require more careful handling than the explosives. If they are accidentally exploded in the presence of dynamite or blasting powder the results are as a rule disastrous. Therefore:

**Always keep detonators away from explosives until it is time to use them.**

## HANDLING AND STORING

Dynamite and blasting powder should be stored in a dry, well-ventilated building or shed, preferably under lock and key, where it will be out of reach of animals, irresponsible persons or children. When large amounts are to be stored or where a supply is constantly kept on hand, a bullet-proof magazine should always be constructed in a secluded spot. Such a magazine can be constructed at a little cost, and plans will be furnished free of cost by this company to all its customers.

NEVER, under any circumstances, store explosives and detonators (blasting caps and electric fuzes) in the same building.

## OPENING DYNAMITE CASES

Dynamite should be left in the magazine in unopened cases until it is needed. These cases should never be opened in the magazine, but one case at a time should be taken some distance away, and then opened with a hard wooden wedge and mallet. If less than a case is needed for the work in hand, the remainder should be left in the case, with the heavy packing paper folded down

over the cartridges and returned at once to the magazine. The cartridges needed for the work should be carried in a wooden box, wooden pail or basket, and should at all times be kept well away from all material that is thrown out by a blast. Special directions for handling dynamite in cold weather will be given in the paragraphs on "Thawing." (See page 19.)

Blasting caps and electric fuzes should be kept in the original package until used and should not be carried about loose. When enough caps have been removed from a box to allow the remainder to rattle about, the empty space should be filled with a wad of clean, dry paper.

Blasting caps and electric fuzes should always be stored in a dry, clean place where they will not be disturbed. In storing caps, it is imperative that they should be protected against moisture, as the explosive substance they contain absorbs water very readily and deteriorates when damp. As previously stated, blasting caps and electric fuzes must never be stored with either dynamite or blasting powder. Fuse is non-explosive and may be stored with either dynamite or detonators. In very cold weather fuse may become stiff and should be warmed before being uncoiled to avoid any chance of its cracking.

As some of the ingredients of dynamite can be absorbed through the skin and cause headache, gloves should be worn when handling it, especially if the cartridges are open, or when "priming." When the gloves become badly soiled or stained by the dynamite they should be discarded and a clean pair used. Ordinary cheap cloth gloves are very satisfactory for this work. The best and safest way to destroy the discarded gloves is to burn them **in the open**, never in a stove or fireplace.

**Never handle dynamite carelessly or in metal vessels.  
Never allow it to lie around loose or where it can be  
reached by animals or irresponsible persons.**

**Cattle relish the taste of dynamite and are made sick  
by eating it.**

## THAWING DYNAMITE

Reference has already been made to frozen dynamite.

Ordinary nitroglycerin explosives freeze and become insensitive at temperatures between 45° and 50° F., but the Hercules E. L. F. dynamites do not freeze until after water freezes. When completely frozen, dynamite is hard and rigid, and its condition is thus easily recognized. It is more difficult to ascertain if a cartridge is only partially frozen, and a careful examination should be made of all dynamite used, if the thermometer registers a temperature near the freezing point of the grade being used.

When dynamite is frozen it often fails to detonate properly on account of being insensitive, and loss of time and of dynamite may be caused by its burning instead of detonating in the bore hole.

Frozen dynamite may be satisfactorily thawed by burying the unopened cases in fresh manure for a day or more. It may then be carried to the work in a thawing kettle or well wrapped so that it is protected from the cold. For thawing small amounts of dynamite no other means is as satisfactory as the thawing kettle which is illustrated on page 15.

In using the thawing kettle it must always be remembered that under no circumstances must the water be heated in the kettle, even though the explosives be first removed, because nitroglycerin exudes very readily from warm dynamite, and enough of it is liable to be found in the bottom of the explosive compartment of a thawing kettle that has been used for some time, to cause a serious accident if the kettle is placed over a fire.

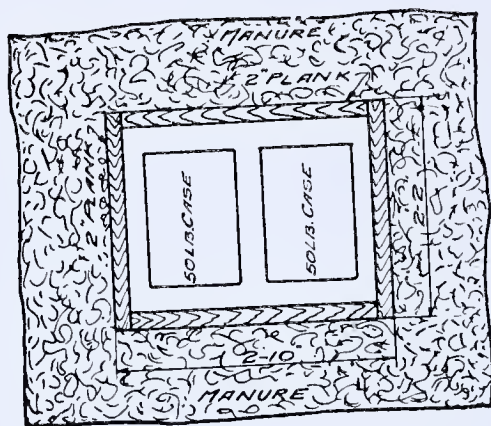
The hot water must always be tested before filling the dynamite compartment. If it is hot enough to burn the hand, do not put the explosives in the thawing kettle. Never fill the water bucket unless the explosives compartment is empty, and see that the explosives compartment is perfectly dry before it is filled. A thawing kettle should be frequently cleaned, first with clean sawdust, then with a dry cloth.

Catasauqua thawing kettles are made in two sizes as follows:

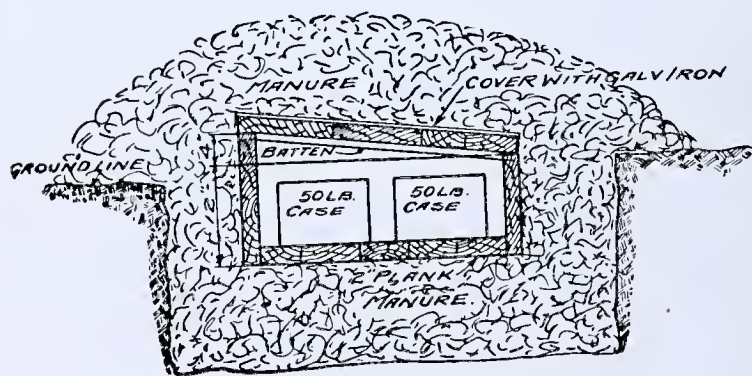
	Dynamite Capacity	Weight Empty	Weight of Water	Total Weight Filled	Outside Dimensions
Catasauqua No. 1..	30 lbs.	12 $\frac{1}{2}$ lbs.	40 lbs.	82 $\frac{1}{2}$ lbs.	14 x 14 $\frac{1}{2}$ in.
Catasauqua No. 2..	60 lbs.	17 $\frac{1}{2}$ lbs.	77 $\frac{1}{2}$ lbs.	155 lbs.	17 $\frac{1}{2}$ x 21 in.

When dynamite is to be used continually in cold weather a permanent manure thawing box can be constructed and will be found both convenient and economical. It is made of strong boards, preferably 1½ or 2 inches thick, with sloping lid. This is placed in a pit large enough to receive it, and at the same time to permit the packing of sufficient manure between the box and the earth on the sides and bottom, and also on top, so as to furnish a considerable amount of heat when it is in use. The size of the pit will depend on the amount of manure it is necessary to use as packing according to whether the manure is fresh or old. Since the depth which it may be necessary to make this packing varies with the nature of the climate, as well as with the frequency with which it may be convenient to renew the manure, it is impossible to give definite dimensions for this pit, but remember that most dynamite freezes at between 45° and 50° F., and that the amount of protection necessary should be gauged accordingly.

The box shown in illustration herewith is designed to hold 100 lbs. of dynamite in 50-lb. cases, but the dimensions can be increased



PLAN.



SECTIONAL ELEVATION

to hold much larger quantities. Be sure, however, in planning the box to have at least two inches space between the cases and between the cases and the box, to permit of uniform thawing and convenient handling. Also be sure to have sufficient manure packing to insure the generation of the right amount of heat to bring about complete thawing. For very large amounts of dynamite are to be used in cold weather, a thawing house heated by steam or other methods is very satisfactory. Plans for such a building will be furnished free of cost on request made to this company.

REMEMBER THAT THAWING CAN BE LARGELY ELIMINATED BY THE USE OF HERCULES E. L. F. DYNAMITE.

## PRIMING

"Priming" is the inserting of the detonator, whether blasting cap or electric fuze, into the dynamite cartridge. When cap and fuse are used, it is first necessary to attach the cap to the fuse. The fuse should be cut into lengths long enough to reach from the charge when loaded in the hole to at least three or four inches above the hole. One cap is then taken from the cap box by covering all of them, except one, with the box lid or with the hand and allowing the loose one to slip gently into the free hand. Do not try to pick caps out of the box with tweezers, nails, or any hard substances as they are likely to be accidentally exploded. Slip the cap carefully over the end of the fuse, taking care not to push the fuse very hard against the explosive charge loaded in the bottom of the cap and do not twist the cap on the fuse. When the fuse is pushed to the bottom of the cap, make a crimp not more than  $\frac{1}{4}$  inch from the open end of the cap by using a Hercules cap crimper. By a glance at the accompanying illustration you can see exactly how this is done. Such crimp made by a Hercules cap



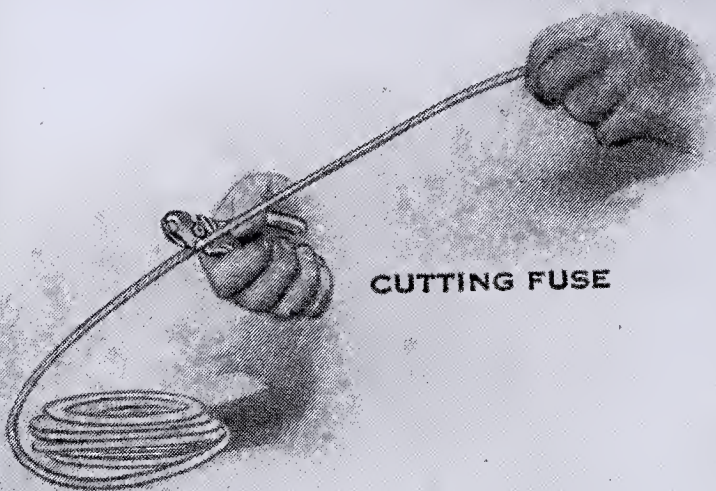
BLASTING CAP CRIMPED ON FUSE WITH A HERCULES CAP CRIMPER

crimper attaches the cap to the fuse more firmly than is possible by any other means. It also makes a watertight joint that would not otherwise be possible.

There are two well-accepted methods of priming dynamite—placing the detonator in the end of the cartridge or in the side of the cartridge.

When priming in the end, the paper is folded back at one end of the cartridge and a hole made with a wooden punch about the size of a lead pencil or with the straight handle of the crimper into the exposed dynamite. The cap with fuse attached is inserted into this hole and the paper drawn together and tied tightly. For very wet work or shooting under water the lower end of the fuse, and the paper which has been tied around it, should be covered with soap or tallow to make it waterproof. Never use oil or thin grease for this purpose. This method of priming is decidedly the best, especially for wet work. It is fully illustrated on the next page.





CUTTING FUSE



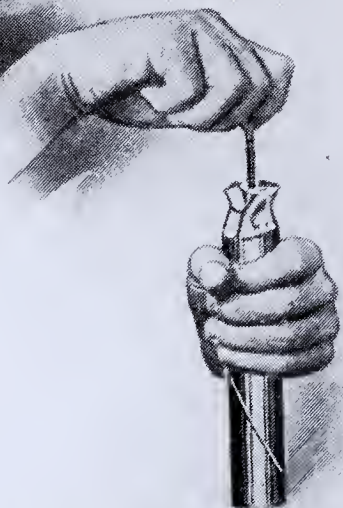
TAKING OUT CAP



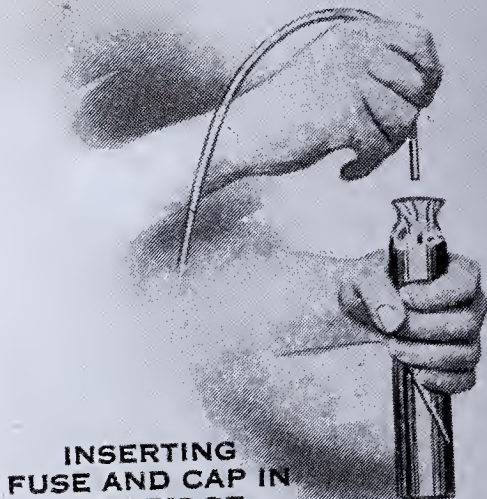
PLACING CAP ON FUSE



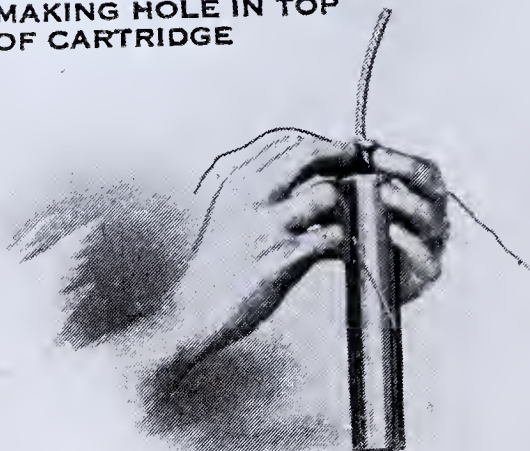
CRIMPING



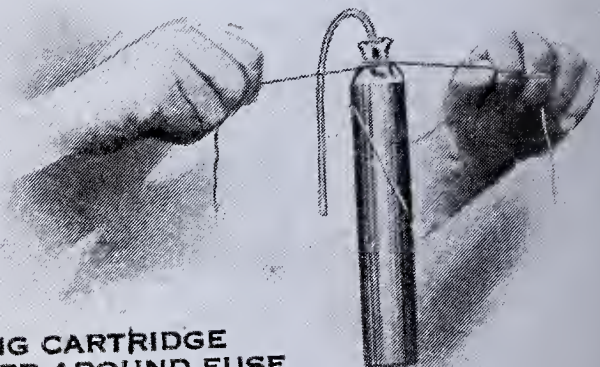
MAKING HOLE IN TOP OF CARTRIDGE



INSERTING FUSE AND CAP IN CARTRIDGE



FOLDING CARTRIDGE PAPER AROUND FUSE



TYING CARTRIDGE PAPER AROUND FUSE

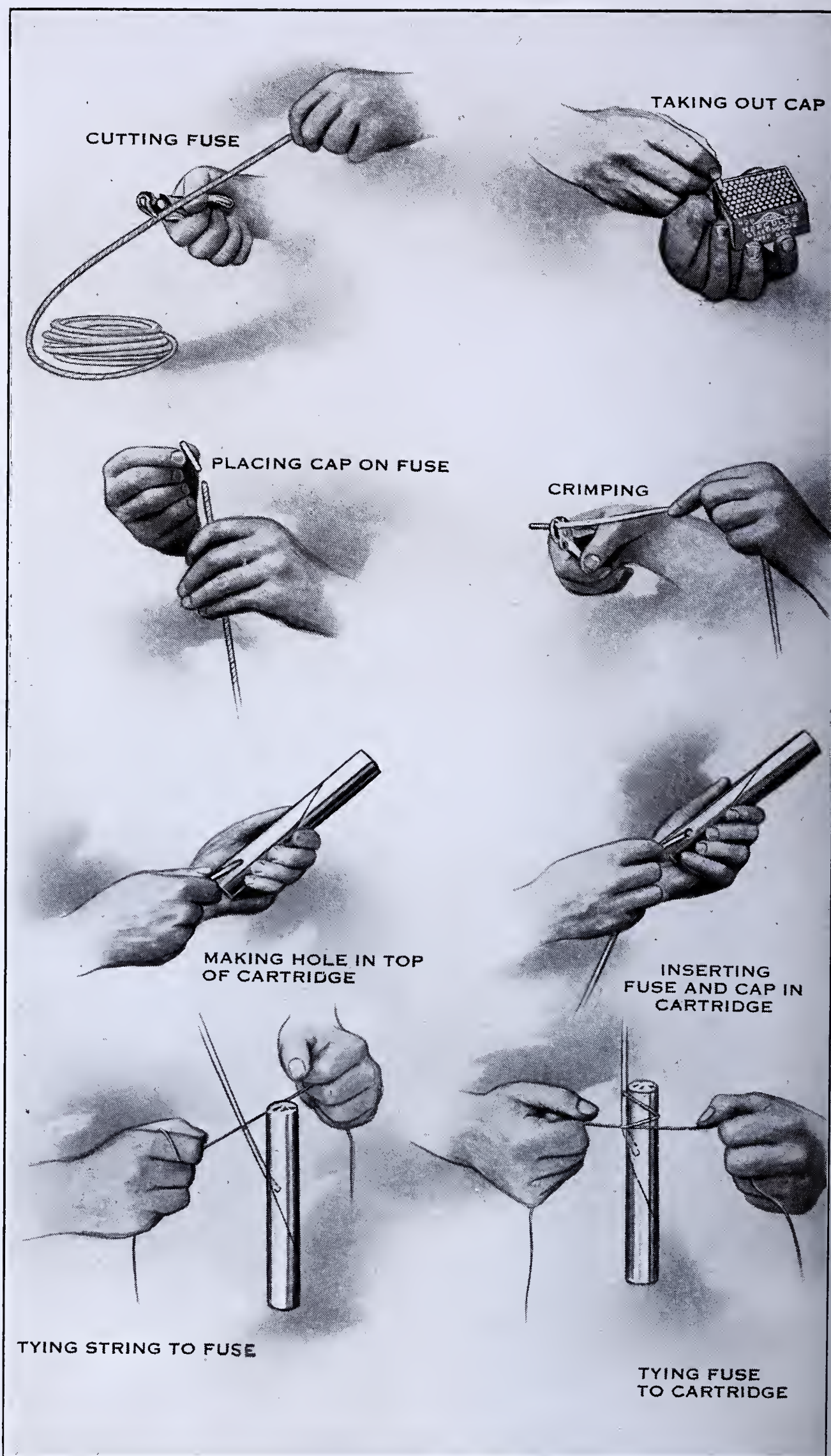
ONE METHOD OF MAKING A PRIMER WITH BLASTING CAP AND FUSE  
(SAME PROCESS WITH ELECTRIC FUZE)

For priming in the side of a cartridge, the hole should be punched at a sharp angle to the side of the cartridge, pointing toward what would be the lower end of the cartridge when loaded in the bore hole. This hole should be punched to a sufficient depth to receive the entire cap and should be so placed that the loaded end of the cap will not extend through the cartridge to the paper on the other side. The fuse is then brought up alongside the cartridge and fastened with a piece of string. This method is clearly illustrated on page 24. Do not use this method of priming in wet work; place the detonator in the end of the cartridge.



**Never lace fuse through a  
cartridge of dynamite.**

Primers are made with Hercules electric fuzes in the same way as with cap and fuse. Do not fasten the fuze wires to the cartridge with a half hitch, as a pull on the wires is likely to injure the insulation, thus causing a short circuit and a consequent misfire.



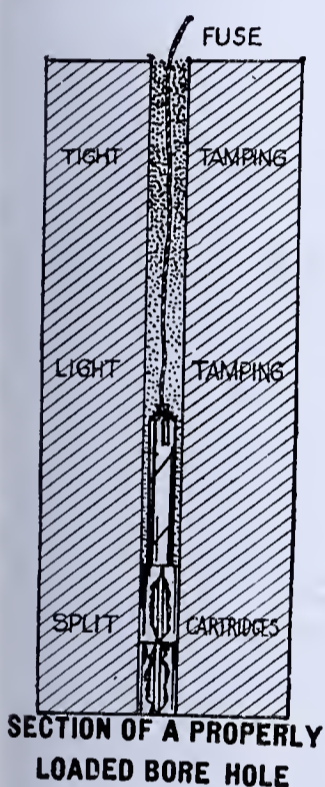
ANOTHER METHOD OF MAKING A PRIMER WITH BLASTING CAP AND FUSE  
(SAME PROCESS WITH ELECTRIC FUZE)

# LOADING AND TAMPING

Both loading and tamping should be carefully done, for mistakes will greatly lessen the effectiveness of the explosives.

## LOADING

If more than one cartridge is to be loaded, those not used as primers are first pressed firmly into the bottom of the bore hole one at a time. If the hole is dry and larger in diameter than the cartridges, the paper on two or more sides of the cartridges should be split with a sharp knife. This will allow them to be spread out and to fill the bore hole completely, excluding all air spaces. If air pockets are left in or about the load, a considerable amount of the explosive force is used up in compressing the air, and there is thus a corresponding decrease in the work done by the blast. When all of the charge is packed into the bore hole, the primer is inserted and pressed gently but firmly against the rest of the load, care being taken that the fuse or fuze wires are long enough to reach a few inches out of the hole. If one, or less than one cartridge is used for a load, it should be made



into a primer and placed in the bottom of the hole in the same manner as the primer is placed on the top of the load just described.

Do not force the primer into the bore hole, as it contains a detonator and is therefore much more sensitive than the unprimed cartridge. If the bore holes are small the cartridges should always be primed in the end.

## TAMPING

When all of the charges of dynamite and the primer cartridge are in the hole, pour in a small amount of loose dirt or sand that will run freely around the primer cartridge and press it down gently but do not tamp hard. Then fill in two or three inches more of the same material and tamp gently. When five or six inches of tamping covers the primer, the tamping should be very vigorous, but not harder than can be easily done with one hand, forcing the wooden tamping rod downward. The hole should be tamped full.

Good material for tamping is usually convenient, as damp clay or loam make excellent tamping material. Always be sure that the holes are tamped firmly enough to prevent a "blow-out," as a "blow-out" will materially reduce the effectiveness of the blast.

For ditching and stumping when charges are covered with a few inches of water, it is unnecessary to use any earth tamping, as the water will confine the charge.

**Never use anything except a wooden tamping stick, such as is described on page 31.**

## CONNECTING UP AN ELECTRIC BLAST

For firing a number of shots at the same time, as is necessary when blasting ditches through dry material, blasting large stumps or boulders, and in splitting logs, a blasting machine is used in connection with electric fuzes or electric squibs. After the charges, primed with fuzes, are loaded, the wires are connected in series;

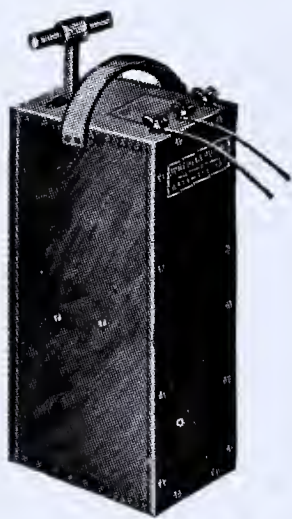
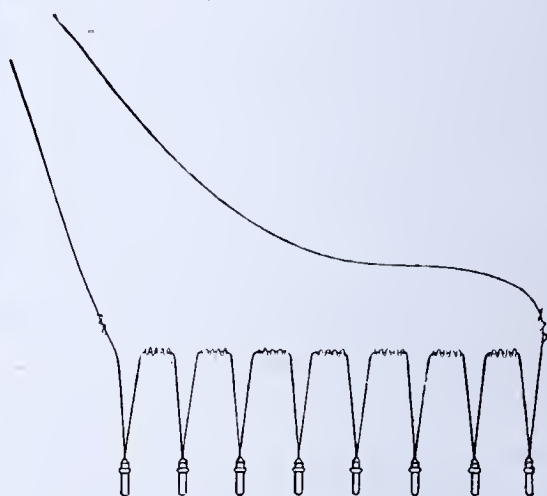
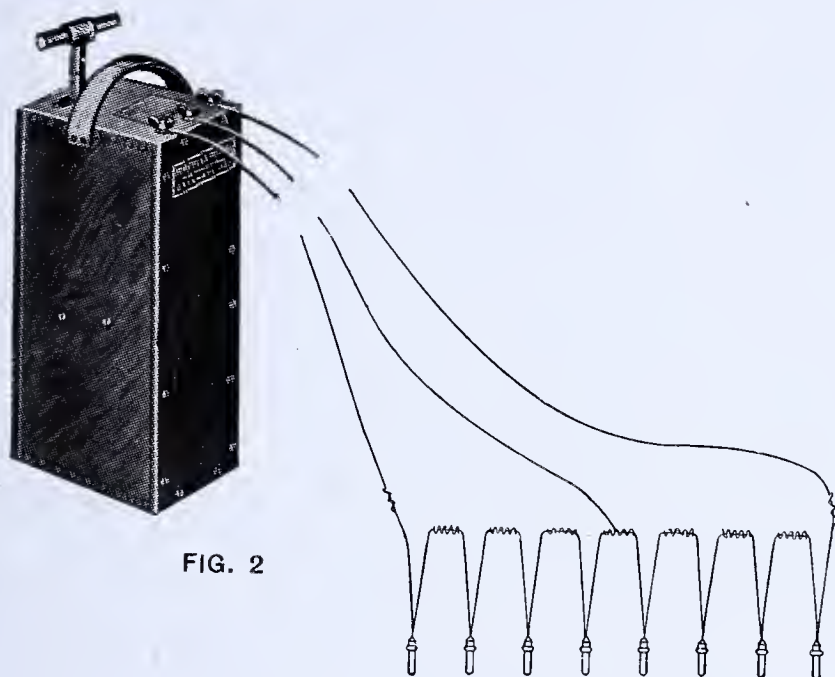


FIG. 1



one wire from the first hole is connected to the leading wire, the other wire to one wire of the second hole. The free wire of the second hole is then connected with one wire in the third hole, and so on until the last hole is reached, when one wire is left free to be attached to the other leading wire. The blast is then ready to fire.

When all persons are out of danger, attach the leading wires to the two posts of the blasting machine, raise the rack bar to its full height and force it down as far as it will go and as hard as possible. Never attach the wires to the blasting machine until ready to fire, and always disconnect the wires from the blasting machine as soon as the blast is made.



When a two-post machine is used, there is no way of getting confused in connecting the leading wires to the machine. When two posts of a three-post machine are used, connect one of the leading wires to the center post and the other to either of the outside posts, as shown in Fig. 1. When using a three-post machine up to its full capacity, it is necessary to use all three posts, in which case the two extreme ends of the blasting circuit, or line of loaded holes, are connected with the outside posts by the leading wires, and a third wire is run from the center of the blasting circuit or the middle hole of the charge, to the center binding post. This is illustrated in Fig. 2.



PREPARING FOR THE CHARGE—USE OF THE SUBSOIL BAR



PREPARING FOR THE CHARGE—USE OF THE WOOD AUGER

## TOOLS NEEDED FOR ORDINARY FARM BLASTING

A few inexpensive tools are needed for ordinary blasting on the farm. Two of the most convenient of these are the drive point, or subsoil bar; and the punch bar.

### THE SUBSOIL BAR

The subsoil bar, which is illustrated herewith, can be made by any blacksmith, as it is simply a piece of ordinary  $1\frac{1}{2}$ -inch sexagonal, octagonal or round tool steel, drawn to a point at one end. It should not be less than 30 inches in length. Where it is necessary to work deeper, as in very deep subsoiling or ditching, it must be increased in length accordingly. This is driven into the tight subsoil or under a stump or boulder, to the desired depth by means of a heavy sledge. It should then be hit a few times on two or more sides until it is loose enough to be pulled out with the hands. If for any reason it should become fastened



SUBSOIL BAR

in the ground, it may be released by taking a half hitch around the top with a light chain and twisting it by means of a stout stick or crowbar, thrust through a loop in the chain. It may also be pulled out using such a device for a lever and a stone or piece of wood for a fulcrum or heel. It is useful in putting down holes for subsoiling, tree planting and ditching in dry or hard ground, stumping and boulder blasting.

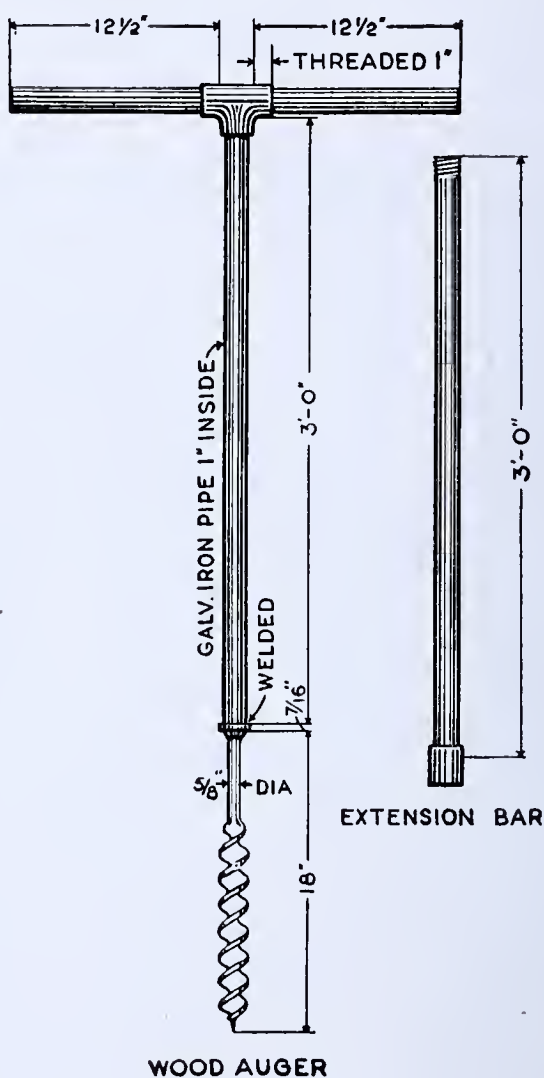
### PUNCH BAR

This tool is also very convenient. It can be made by any blacksmith who has a die for threading  $1\frac{1}{4}$ -inch pipe; or the pipe may be obtained already threaded from a plumber, steam-fitter or from a general mill supply store. Two pieces, each 12 inches long, are threaded on one end. These are screwed into a  $1\frac{1}{4}$ -inch tee for a handle. A third piece, which is the shaft or punching part of the tool, is made three feet long and threaded at one end. A steel point, not less than 6 inches in length, is

shrunk and keyed into the lower end. In some cases, for deep work, it may be better to make the shaft longer than three feet. For very deep work, an additional length or lengths of pipe may be added to the shaft by means of couplings, to get the desired depth. This tool is very useful in ditching and in stump and boulder blasting, but is not suitable for ordinary subsoiling or tree planting. It should not be driven with a hammer or maul but is pressed into the soft ground by the weight of the workman. It will often be found advantageous to punch a hole a few inches in depth, withdraw the bar and pour in a small amount of water. This acts in the nature of a lubricant and reduces the effort necessary to make the hole. The wood auger shown below gives a very good idea of how a punch bar should be made.

## AUGERS

Two types of augers are used in agricultural blasting; the earth auger and the wood auger. The earth auger differs from the ordinary wood auger in having a longer gimlet point on the bit to enable



it to feed into the ground better. Both augers are manufactured by Job T. Pugh, 31st and Ludlow Streets, Philadelphia, Pa., and will be found useful in stump and boulder blasting and examining

soils to locate hardpan. These augers can also be had by applying to the Salt Lake City or San Francisco offices of the Hercules Powder Company.



DIRT AUGER

For stumping, especially where tap roots are encountered, an ordinary  $1\frac{1}{2}$  or 2-inch wood auger, with a long shank, will be needed, as will be pointed out under the general head, "Stumping."

### TAMPING STICK

This is for pressing the dynamite into the bore hole, and for packing in the dirt filling or tamping, which confines the dynamite for the blast. A tamping stick must always be of wood and without metal parts. For light work, in small, shallow holes, an old broom handle is ideal. For deeper and larger holes a small shovel, rake, or hay fork handle cut off square—not pointed or rounded—makes a good stick. For very deep work or large holes, a hardwood sapling may be cut and trimmed free of projecting knots and rough bark.

### PROBE OR PUNCH

For locating the heavy roots under stumps and examining the size of the underground parts of boulders, a long probe, similar to the end-gate rod of a wagon, will be found very useful. This should be drawn to a long, sharp point.

### OTHER TOOLS

The only other tools needed are a sledge hammer, mattock and shovel. These are to be found on most farms or can be had at little expense.



A CROP OF BOULDERS LIKE THIS MAKES CULTIVATION DIFFICULT



SPLIT THEM WITH HERCULES DYNAMITE AND THEY ARE EASY TO HANDLE

# THE USE OF HERCULES E. L. F. DYNAMITE AND BLASTING POWDER ON THE FARM

---

## BOULDER BLASTING

Many fields are troubled with boulders which impede cultivation and the harvesting of crops. Such boulders also take up much valuable ground and decrease the yield of crop per acre, as well as increase the cost of field operations. When these are too large to be easily loaded on a stone boat, there is no method of removing



LARGE BOULDER BROKEN INTO PIECES THAT CAN EASILY BE HANDLED

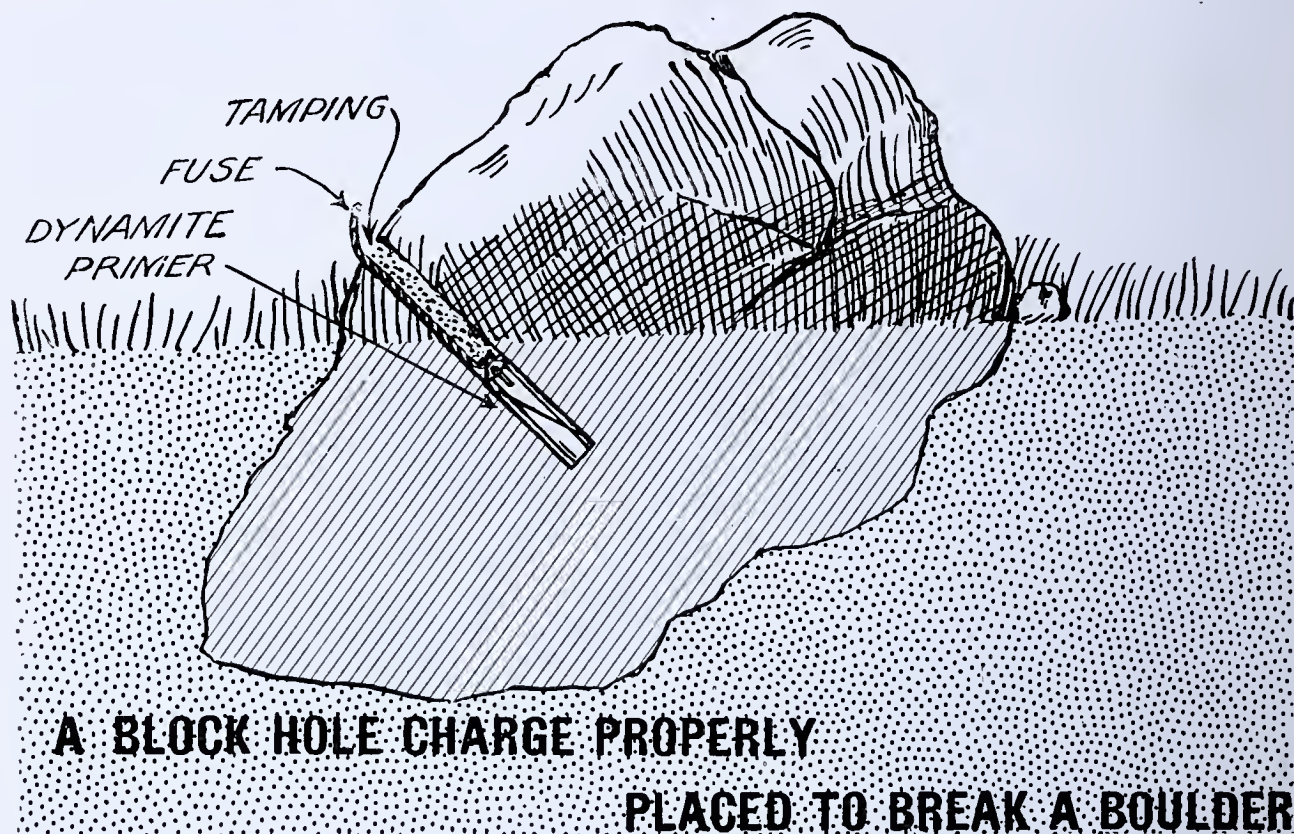
them so satisfactory as blasting them with dynamite into fragments that can be easily handled. For boulder blasting three distinct methods of loading are employed; blockholing, snakeholing and mudcapping.

### BLOCK HOLES

The oldest method of blasting boulders is to drill a hole into the boulder, as shown in illustration herewith, and load with a small amount of Hercules dynamite. This hole should be so located and

at such a depth, that the charge of dynamite loaded in the bottom of the hole is near the center of the boulder. Such a blast will shatter the hardest boulders known.

For this work Hercules E. L. F. Extra 40% Strength dynamite is recommended, but if only a small amount of work is to be done, any standard grade as strong or stronger than 25% is satisfactory. For large boulders the bore holes should be at least  $1\frac{1}{4}$  inches in diameter. This will permit the loading of unbroken cartridges of standard size. The amount of load for each hole will

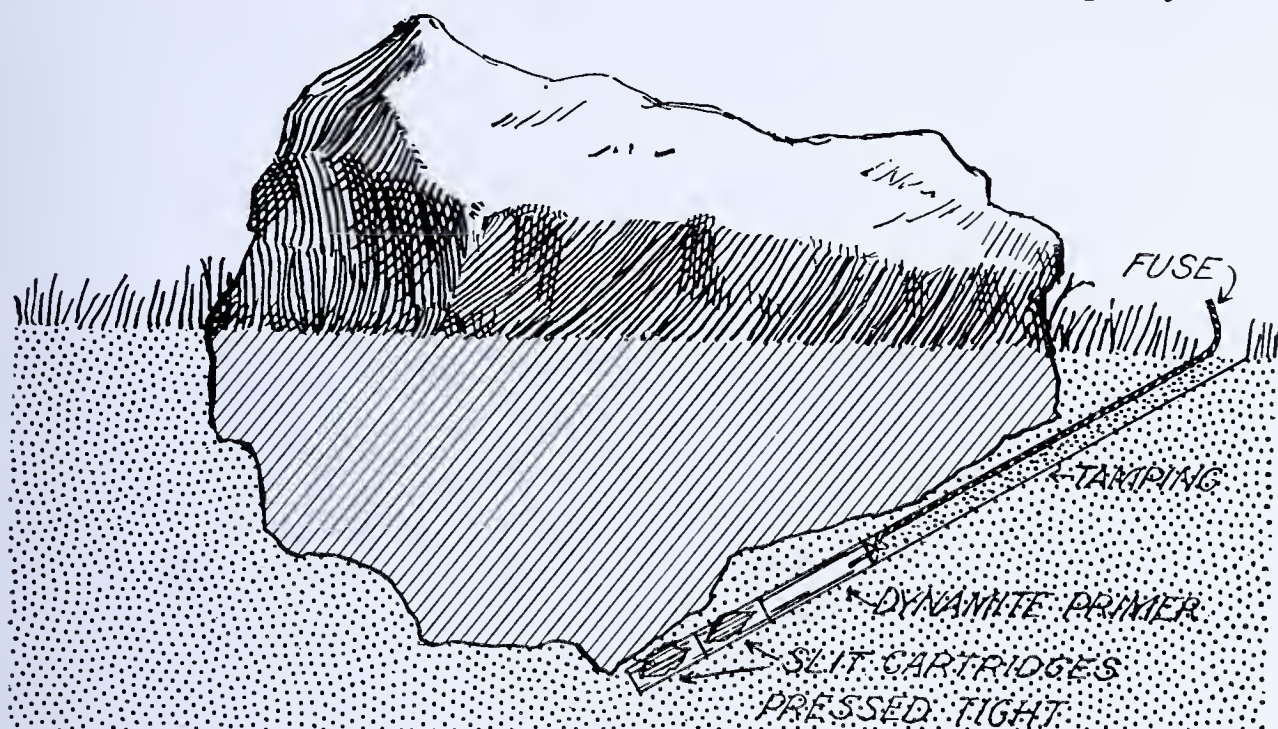


vary with the size and hardness of the boulder. For extremely large boulders and ledges, several holes should be used and fired with a blasting machine. For small boulders the holes may be made with an ordinary hand drill and may be smaller than  $1\frac{1}{4}$  inches in diameter. In such a case it will be necessary to remove the dynamite from the paper shell and press it into the hole. The cap is then inserted into a hole which has been made in the packed charge of dynamite with a pointed stick. After loading bore holes of this kind the charge must be confined by tight tamping, as is described on page 25.

## SNAKE HOLES

In breaking boulders by this method, holes are made in the ground under the boulder with a crowbar, drive point, punch bar or auger, so that a charge of Hercules dynamite can be placed immediately under and against the heaviest and strongest part of the boulder. The dynamite recommended for this work is Hercules

E. L. F. Extra of 40% strength, but if stronger dynamite is already on hand it can be used to good advantage. This is packed tightly in the bottom of the bore hole, after which the hole is tamped full and the shot fired. Such a blast, if properly loaded,



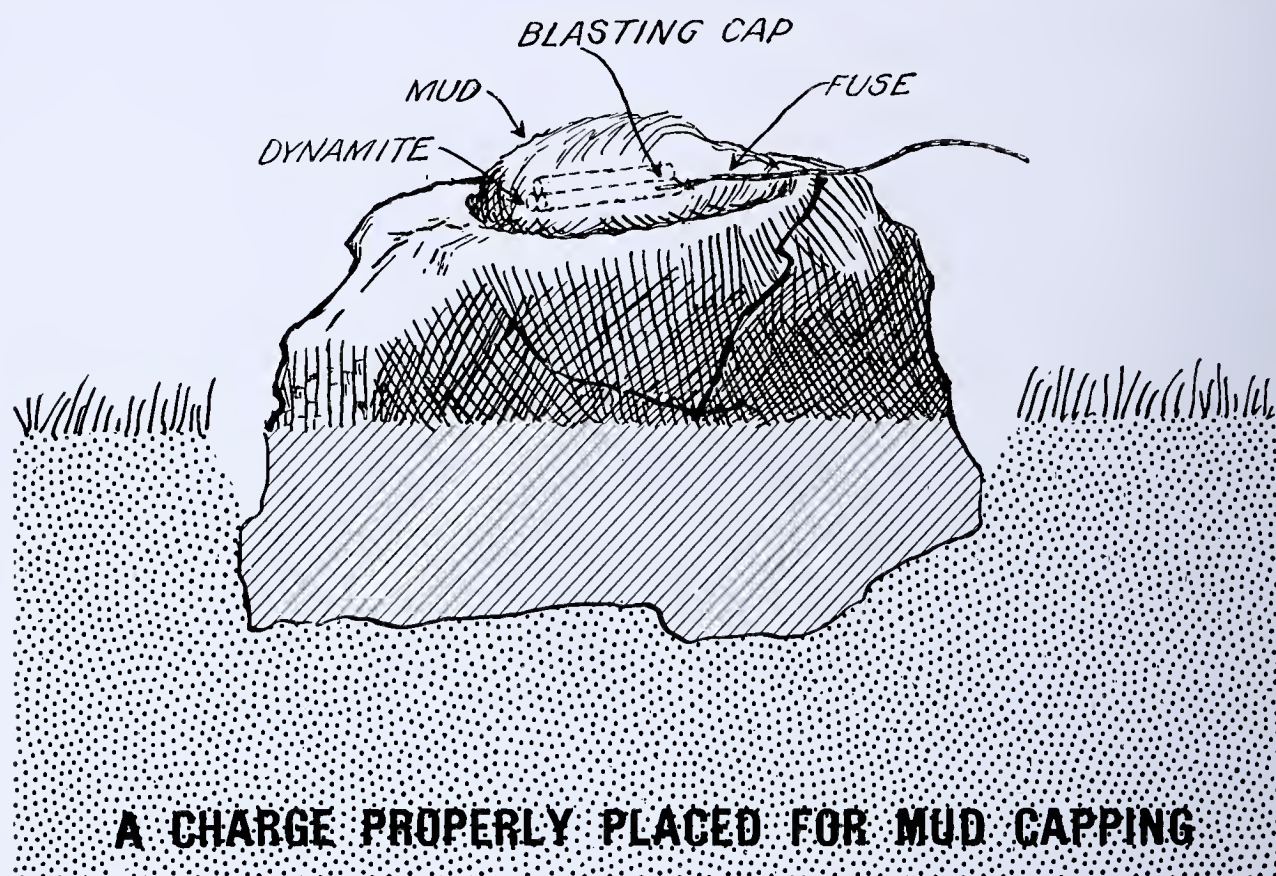
### **CORRECT METHOD OF BLASTING BOULDER BY SNAKE HOLE**

will lift the boulder out and shatter it into fragments that can be handled. This method, with light loading, can be used for lifting out boulders when it is not desirable to shatter them in place, as is often the case when boulders are first blasted out and then broken with mud caps. Either Hercules blasting caps and fuse or Hercules electric fuzes may be used for detonating.

### **MUD CAPPING**

This method of boulder blasting is also called "Blistering," "Bull Dozing," or "Doby Shooting." Pick out the point on the boulder where it would be struck with a hammer if it were possible to break it by this method. For large boulders where a heavy load will be necessary, the cartridges may be laid on the boulder at the point selected in a neat pile, leaving as little air space between them as possible, with the primer cartridge in the center. This should then be covered and surrounded with a heavy cap of mud, or moist clay or loam, to a depth of at least six inches. For small boulders, where only a light load is necessary, it is better to remove the dynamite from the paper shells and press it closely against the boulder in a low pyramid, inserting the cap into this

pile of dynamite and surrounding the charge with mud, as has just been described. Where boulders are imbedded in the ground better results will be obtained if the earth is dug away from the sides before blasting. A sufficient length of fuse or leading wire



should be used to permit the blaster to be at a safe distance from the blast. The dynamite found best and recommended for this work is Hercules E. L. F. 60% nitroglycerin dynamite.

## COMPARISON OF DIFFERENT METHODS OF BOULDER BLASTING

No fixed rules can be laid down for the selection of the best method for blasting boulders in any locality, on account of the variation in the cost of drilling and the hardness of the boulders. The labor cost is greatest for the "block hole" method and least for "mud capping," with the "snake hole" method an intermediate. The cost for dynamite is exactly reversed. Where boulders are flat and not imbedded deeply in the ground, mud capping is usually the most economical. Where the boulders are not abnormally thick or hard and are resting on a solid foundation, the snake holes are quite satisfactory, but for very hard, large boulders, block holes are preferable.

Sometimes it is found advisable to use both the snake hole and mud cap on hard boulders, firing both charges with a United States Standard blasting machine.

## STUMP BLASTING

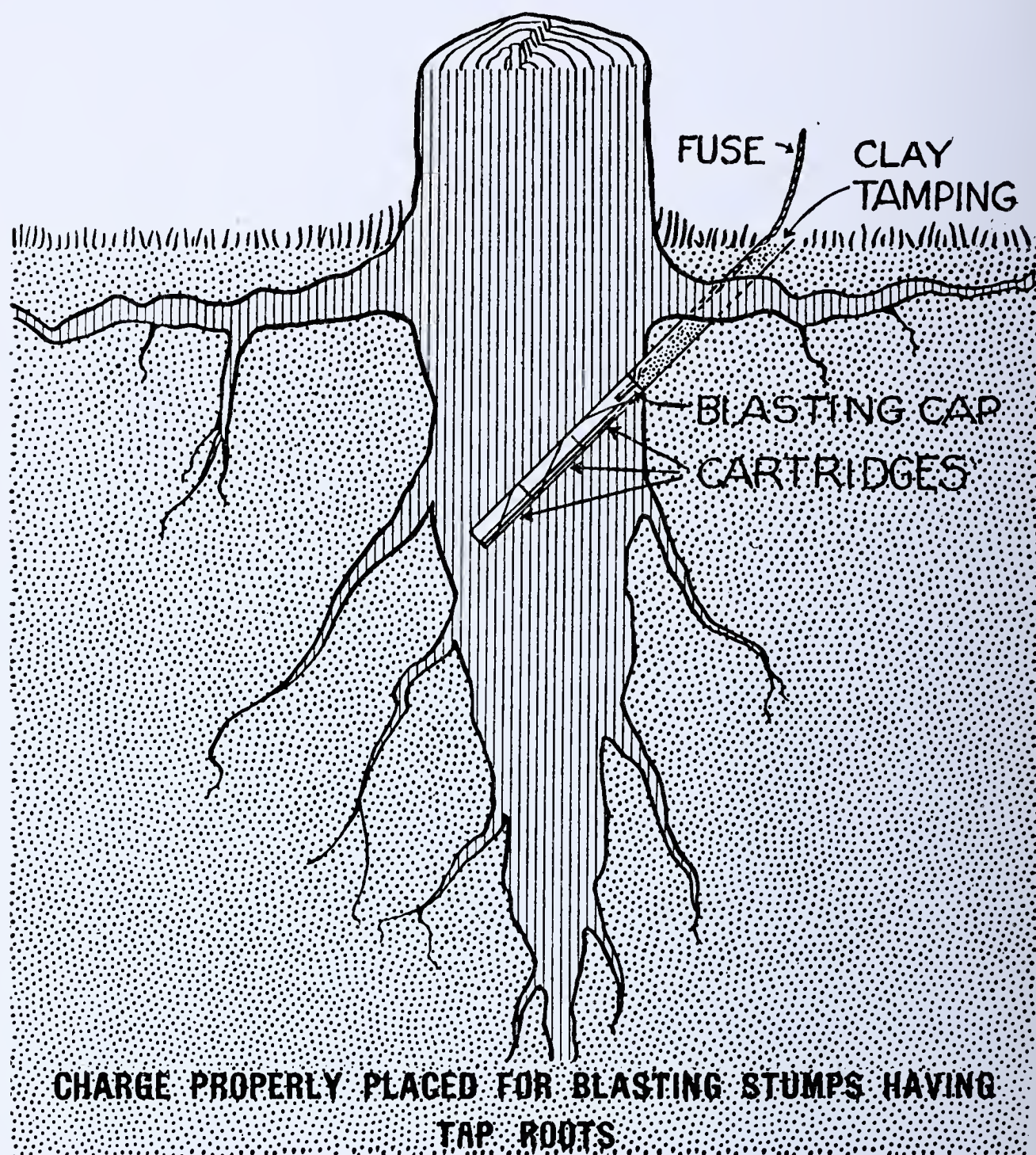
Stumps offer the same impediment to cultivation and crop production as boulders, and their removal is just as important and necessary. Many thorough tests, covering a long period of time, have proved that the cheapest, quickest, most economical and most satisfactory means of ridding a field of stumps is by the rational use of Hercules dynamite or other stumping powder. In swamps or wet places where stumping by other means is practically impossible, good results are obtained by blasting, no matter how wet the soil may be or how large and heavily rooted the stumps are. For blasting the several kinds of stumps, it is necessary to load them with special regard to their root systems.

### BLASTING TAP-ROOTED STUMPS

Trees similar to the pine, when not interfered with by hardpan, usually send down heavy tap roots. For blasting these, the best method is to start a hole in the ground some distance away from the stump, as is shown in the accompanying illustration so that it will reach the center of the tap root about fifteen to eighteen inches below the surface of the ground; or deeper, if the nature of subsequent tillage will be interfered with by fragments of stumps or roots left in the ground at this depth. Then using a wood auger, bore a  $1\frac{1}{2}$  or 2-inch hole about three-fourths of the way through the root, and load it with Hercules E. L. F. Extra dynamite of 40% strength, using the methods and precautions described on page 00. Split all cartridges, except the primer, and pack as much of the charge as is possible into the hole in the wood and place the remainder as close to the wood as possible. Use Hercules No. 6 blasting cap and fuse, or Hercules No. 6 electric fuze if you are using a blasting machine.

As the loading of such stumps will vary considerably, due to the variations in the toughness of the roots, their state of preservation, whether green or somewhat decayed, and the resistance offered by the soil in which they grow, no set rules can be laid down for the amount of dynamite needed for any given size of stump. Fresh green stumps are much harder to blast than similar ones that have been cut for a year or more. The only way to gauge the loading is by experience. Try a few, loading

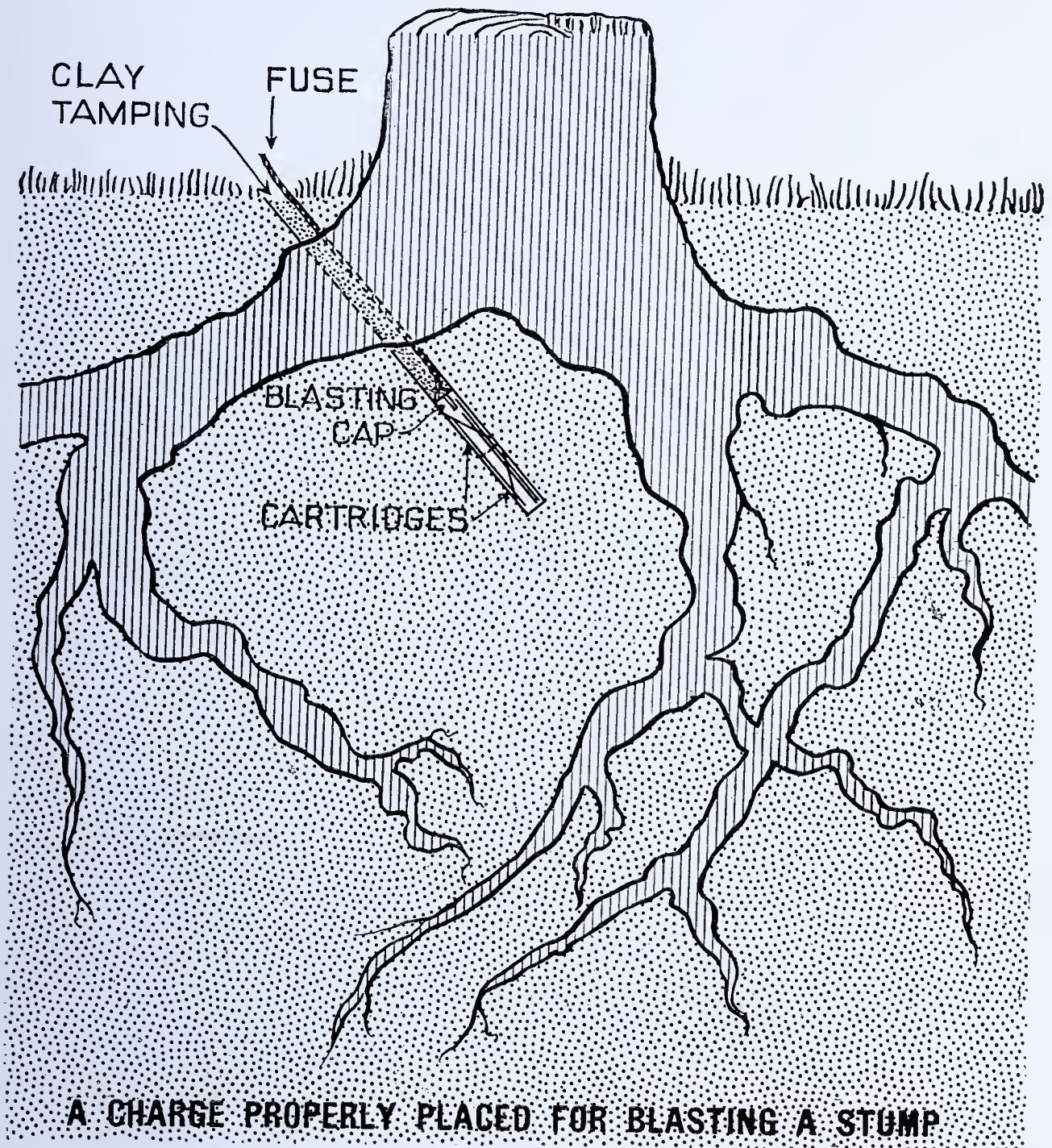
the first one heavier than you feel necessary and later cut down the amount of dynamite used until there is no overloading. It is better to over-load a stump slightly than to under-load it, for when a stump is once shattered by a charge not large enough to lift it out of the ground, portions of the stump and root are left clinging in the hole and are removed with difficulty.



The novice should begin on the small stumps and work up to the large ones. Take a stump about twelve inches in diameter at the surface of the ground, and start your hole back about fifteen inches, boring to within three inches of the far side of the root. Load this with two cartridges and carefully note the results. If the loading is too light, try more dynamite in the next one; if too heavy, try less.

## BLASTING SMALL FIBROUS ROOTED STUMPS

Some classes of forest trees are supported by stumps having no tap root but many heavy lateral roots. These can also be blasted easily. For such a stump the method of loading is to punch a hole under the stump at an angle with the surface of the ground

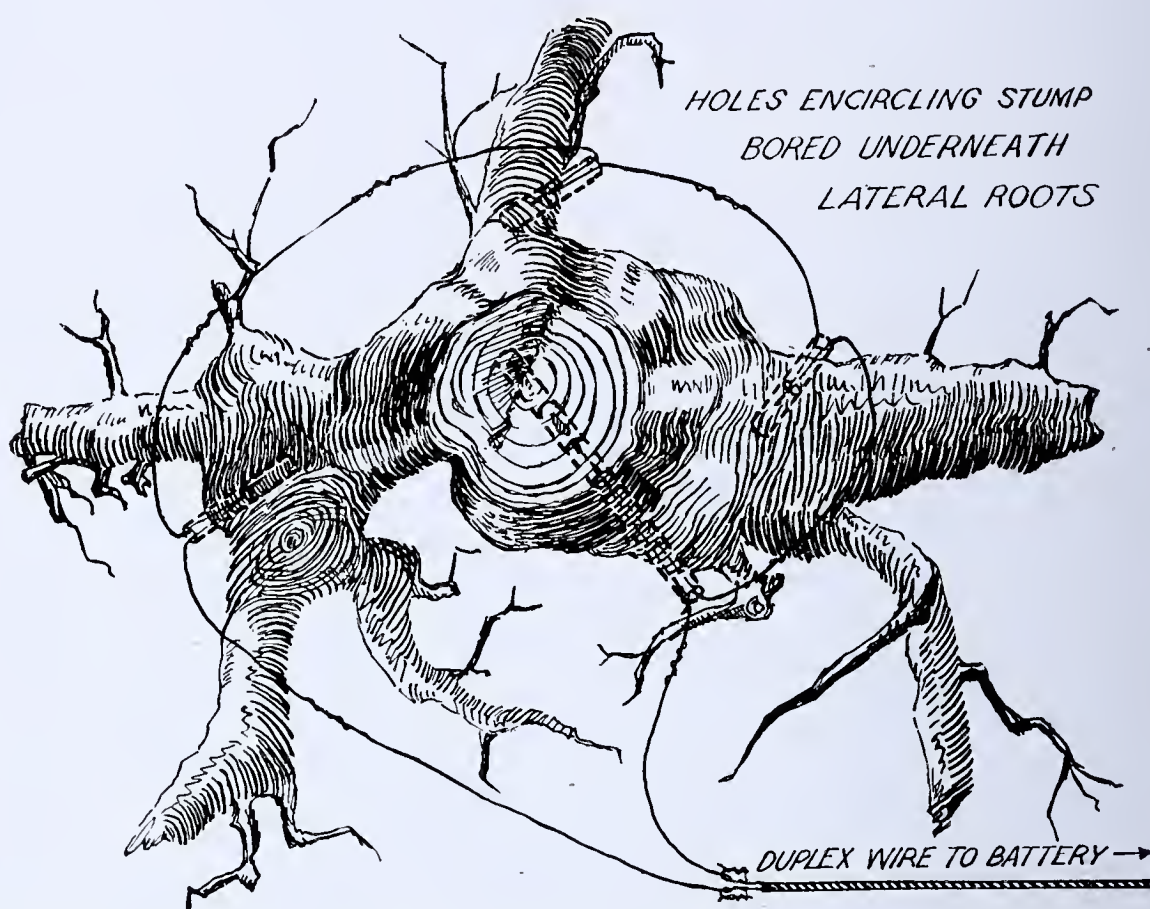


to a depth of about eighteen to twenty-four inches. This hole should be so placed that the major portion of the dynamite is directly under the heaviest part of the stump, and should ordinarily extend decidedly more than half-way under the body of the stump, in order to avoid danger of loading a blast too near the side, and lifting out only a part of it and its roots. The best explosive for this work is Hercules E. L. F. Extra dynamite

of 40% strength. In beginning such stumping, follow the same general instructions as for blasting tap-rooted stumps. The method of loading is shown in the accompanying illustration.

## BLASTING LARGE FIBROUS ROOTED STUMPS

When stumps are too large to be successfully blasted by a single charge, the method of loading should be modified as follows: A hole is put down under the stump and loaded as described for small fibrous-rooted stumps, the only difference being that a Hercules No. 6 electric fuze is used instead of the cap and fuse. Addi-



**DIAGRAM SHOWING CORRECT LOCATION OF HOLES AND PROPER WIRE CONNECTIONS FOR REMOVING STUMPS HAVING LARGE LATERAL ROOTS**

tional holes are punched under the large roots and loaded with small charges, each primed with a fuze. The wires are then connected, as shown in the illustration herewith, and the shot is fired with a blasting machine. The explosive used is Hercules E. L. F. Extra dynamite of 40% strength.

This method of loading is also recommended for blasting second growth stumps and those having hollow centers, for with such stumps a single charge is quite likely to split the stump without lifting it out.

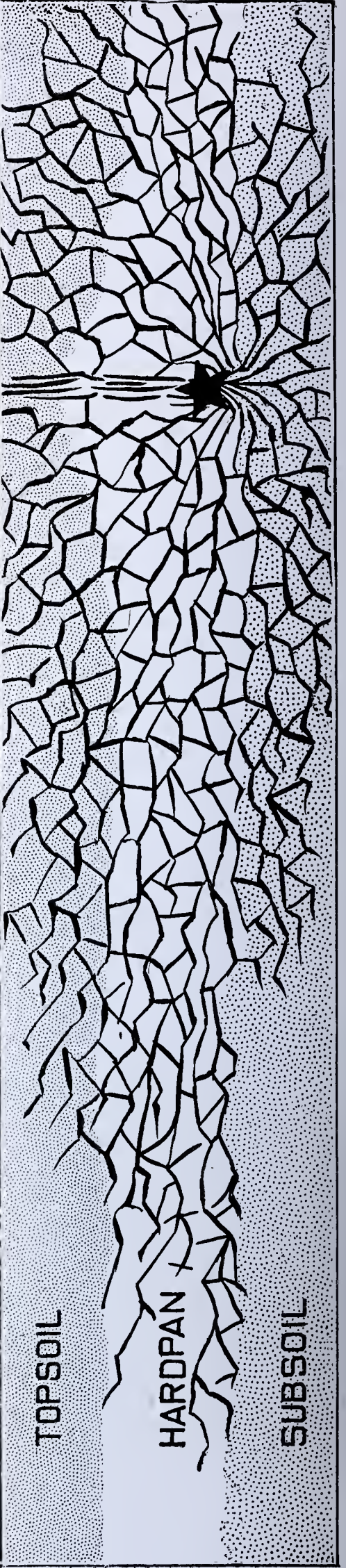
## WESTERN FIR, PINE AND CEDAR

In the Pacific Coast States, these trees grow to enormous size. The roots usually spread out near the surface, but do not grow as deep into the ground as might be expected. Tap roots are extremely rare. The object, when blasting the stumps of these trees, is not to split them, but to bring them out entire with all the roots possible. If the charge of the explosive is so gauged and located as to split the stump it usually fails to bring out all of the roots. It is better to blast it out first and then split it by means of a small charge of dynamite loaded into an auger hole in the thickest part of the stump. The explosive recommended for this work is Hercules E. L. F. Extra 25% dynamite.

On account of the variations in the soil and in the roots of these stumps, no absolutely definite rule can be made for the amount of dynamite required to blast a stump of a given size, but a large number of tests have demonstrated that the following figures can be used as a guide. It will usually be necessary for the blaster, after a few trials, either to increase or decrease the amount of explosive used for the different sizes of stumps. For large stumps it is advisable to use 2 to 2 1/2 pounds of this dynamite for each foot in diameter. The charge of explosives is best placed with sixteen to twenty-four inches of earth between the charge and the bottom of the stump. This results in the force of the explosion radiating on all sides, lifting the stump clear of the ground and bringing with it the greatest length of roots. If the charge is placed too close to the stump the effect is to split it, leaving the roots to be dug out at extra expense. Where a large charge is required, the most economical way to make a hole is to punch or bore a small hole under the stump and load this with a half cartridge of the dynamite and shoot it without tamping. If this does not make a hole large enough to receive the entire charge, spring the hole larger by using a full stick of the dynamite. Do not load this second charge into the hole until the ground has had a sufficient time to cool, and do not, under any circumstances, load the charge for blasting a stump into a chambered hole until a considerable time has elapsed, as there is great danger of the hot soil causing a premature explosion and perhaps injuring the blaster.

## REDWOOD AND BIGTREE STUMPS

The best explosive for these stumps is Hercules R. R. P., which is a comparatively slow-acting powder and has more of a lifting and heaving than shattering effect. This powder is described on page 7.



BLASTING HARDPAN IN KANSAS—SECTIONAL VIEW OF SOIL SHOWS WHAT CAN BE DONE WITH HERCULES DYNAMITE

The way to estimate approximately the quantity of powder needed to blast out stumps larger than eight feet in diameter is to square the largest diameter in feet, the result being approximately the number of pounds required. For example, if a stump is eight feet in diameter the largest way, the charge of Hercules R. R. P. should be  $8 \times 8$  or 64 lbs. Stumps less than eight feet in diameter require a little more charge per foot of diameter than do the larger ones, and the rule with them is to use as many pounds of Hercules R. R. P. as eight times the largest diameter in feet. On this basis a stump five feet in diameter would need  $5 \times 8$  or 40 lbs. of powder. A successful blast depends very much on the judgment of the blaster and these rules can only be considered as a general guide. This can easily be understood when it is remembered that owing to soil conditions, or some peculiarity in the growth of the tree, it sometimes requires the same quantity of explosive to bring out a stump six feet in diameter properly as it does one eight feet in diameter.

In blasting these stumps a hole is dug large enough to permit placing the entire charge of explosive directly underneath the



BIGTREE STUMPS, EASILY LIFTED WITH HERCULES R. R. P.



TREES CAN BE NEATLY LIFTED OUT WITH HERCULES E. L. F. DYNAMITE



FRAGMENTS OF STUMPS BLASTED WITH HERCULES E. L. F. DYNAMITE ARE SMALL IN SIZE AND CAN BE EASILY BURNED

center. A little dynamite placed in holes punched with a crow-bar and exploded will prove of great assistance in digging.

If the ground is wet the powder should be left in the waterproof bags and fired as quickly as possible after loading. All holes must be carefully tamped to the surface.

Hercules R. R. P. can be properly detonated only with a primer of Hercules 40% (or stronger) dynamite, using one pound of dynamite (two  $1\frac{1}{4}$  x 8-inch cartridges) to every twenty-five pounds of the Hercules R. R. P. If several cartridges of dynamite are used for a primer, they should be tied into a compact bundle and placed near the center of the charge. To detonate the dynamite primer, a Hercules No. 6 blasting cap or same strength electric fuze is used. Hercules R. R. P. is very inflammable, and the charge should be so placed that the fuse does not come in direct contact with the powder as it is likely to be ignited prematurely.

Avoid being on the same side of the stump as the hole made below it when the blast is fired, as fragments are thrown with more violence and at a greater distance on that side.

## **FELLING TREES WITH HERCULES E. L. F. DYNAMITE**

Trees can be felled and their stumps and roots removed at one operation by loading under them as under stumps. If the trees are alive, the roots will be strong and will require somewhat heavier loading than would dead stumps. If the body of the tree is valuable for saw timber, care should be taken not to overload, as there is danger of splitting the trunk and thereby reducing its value.

## **STUMPING IN THE ORCHARD**

When removing diseased or unprofitable trees from the orchard in order to set new ones, all stumps should be blasted out, or by this method they are most economically removed and suitable holes are made for setting new trees. An additional benefit is derived if there is trouble from root rot, as the effect of dynamite blasts followed by allowing the holes to air out before re-planting with new trees, controls this disease.

## **GENERAL RULES FOR CLEARING LAND**

Most stump land contains stumps of varying sizes from small to large. Where large tracts are to be cleared a good plan is to first blast the small stumps by means of cap and fuse, where only

one bore hole is necessary. After this is done the land can be gone over once more, using the electric method of blasting to remove the large stumps where it is necessary to use more than one bore hole to get the best results. A well-trained crew of three men, consisting of a blaster and two helpers, can remove a large number of stumps in a short time. The method is as follows:

The two helpers will start boring holes under the small stumps requiring only one hole. The blaster starts making his primers. When he has made ten or more primers, as the case may be, he begins to load the holes. Loading and tamping can be done much faster than the boring. When the blaster catches up with the helpers who are boring the holes they stop, and all three light the fuses in the loaded holes. When the shots are fired the helpers start boring more holes and the blaster begins to make up a new lot of primers. This system will enable a very large number of small and medium-sized stumps to be taken out in a minimum amount of time, provided the work is not so wet as to make the use of caps and fuse inadvisable. After an acre or two have been cleared up the man can start taking out the large stumps requiring two or more holes by the electric method, if enough be present to warrant the expenditure necessary for the electric equipment.

## **DISPOSAL OF STUMP**

When stumps are grubbed or pulled by power machines, they are left whole, with a net-work of unbroken roots holding large amounts of dirt. This renders them very hard to handle and increases the cost of burning them or disposing of them by other means. When stumps are blasted properly they are split apart and broken into fragments that can be easily handled. In many cases stump wood is valuable for fuel or other purposes.

---

# DITCHING WITH HERCULES DYNAMITE

Some idea of the enormous need of ditching can be formed when we realize the area of land in the United States that cannot be successfully farmed until ditched, on account of the swamp and overflow condition rendering it too wet for agricultural purposes. Swamps and overflow lands are a decided menace to health, as they are the breeding places for mosquitoes, which transmit malaria and yellow fever. Good drainage is imperative for good roads.

The Federal Hydrographer has recently estimated the area of swamp and overflow lands in the United States to be about 75,000,000 acres. California alone has 1,850,000 acres of land requiring additional drainage to bring them up to anything like a normal crop-producing condition. These figures do not take into account the many small wet spots that are found on many farms, for the relief of which drainage is necessary. Practically every farm in the humid region needs some ditching, and thousands of farms or ranches in the irrigated districts are becoming unproductive, due to the accumulation of water in the low parts of fields, and the consequent formation of hardpan and alkali. With the needs of improved drainage fully realized, the next thing to do is to select the most economical and satisfactory method of ditching.

## METHODS OF DITCHING

The oldest and best understood method of ditching is the hand method, where the earth is removed by shovels. By this method small or large ditches can be constructed when labor can be obtained for such work. Ordinarily this is difficult as the work is hard, and the conditions so bad, that with the present demand for labor in all lines of work, it is difficult to get men to ditch. This difficulty should always be borne in mind in deciding upon the method you will employ for your ditching. The cost per cubic yard of earth excavated by hand is always high, and at times reaches as much as 25 cents, or even more.

For the construction of large ditches fifteen or more feet in width and of great length, the floating dredge is now being used quite successfully, and is excavating earth at less than half the cost of hand labor. Other methods employed for ditching are traction diggers and combinations of plow, scraper and shovel work. The expense of such methods vary greatly under different conditions



SWAMP LAND IS OF NO VALUE FOR AGRICULTURAL PURPOSES, AND IS A  
MENACE TO HEALTH AND TO GOOD ROADS



DITCH BLASTED THROUGH ROOTS AND STUMPS

of soil and labor costs. Ditching by all of these methods is retarded, and the cost naturally increased, if stumps, boulders or other obstructions are encountered in the ditch, or if the ground is marshy.

### DITCHING WITH HERCULES DYNAMITE

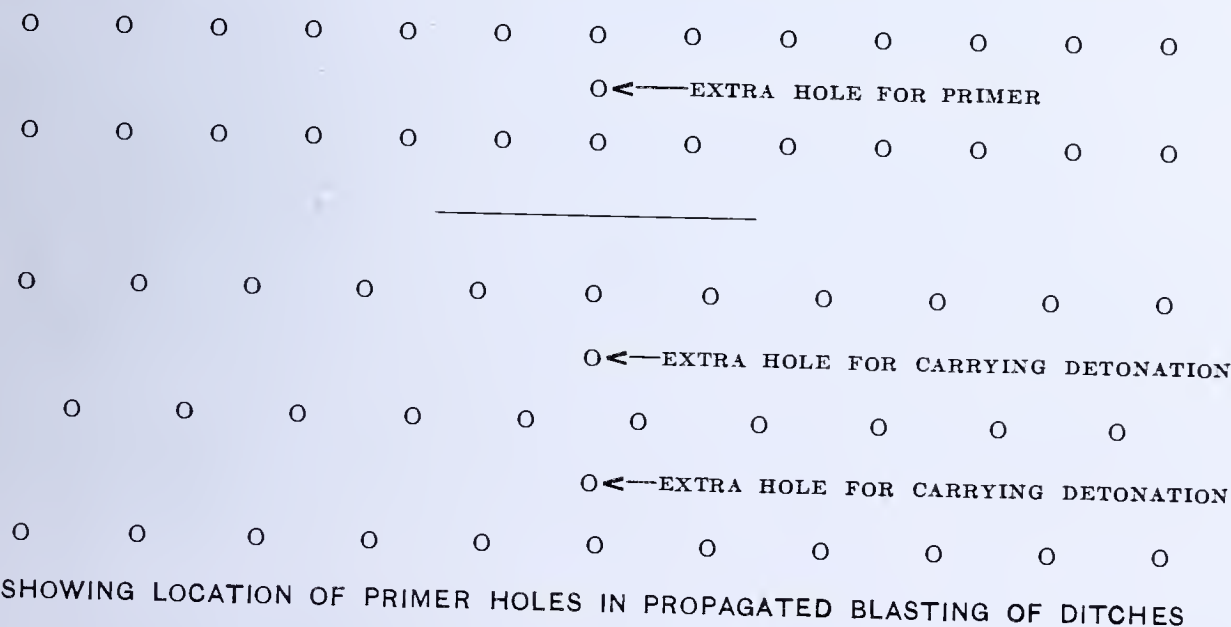
With few exceptions ditches can be excavated by the proper use of dynamite for blowing out all of the earth, or a major part of it, and leaving the remainder in a loose, easily workable condition, that can be handled at a minimum cost by shovel or light horse scrapers.

There are two distinct methods of ditching, each having its advantages for certain kinds of work. These two methods are known as the propagated blast and the electric blast.

### THE PROPAGATED DITCH BLAST

In wet ground or in a swamp, where it is almost impossible to get labor to work, and where the use of machinery is practically prohibited, and where teams are used to great disadvantage on account of the bad footing for draught animals, ditching is accomplished most satisfactorily by means of a propagated blast. This type of ditch is also recommended in all wet or saturated soils where water will rise in the holes punched for the blast, unless the water is cold enough to freeze straight nitroglycerin dynamite, in which case "low freezing" dynamite is used in an electric blast. Ditching with the propagated blast should not be attempted when the water in the bore hole is colder than 50° F.

A line of holes is punched with a punch bar or, if very resistant hardpan is encountered, with a drive point, to about the desired bottom of the ditch. In some soils these holes should be to the



grade of the ditch bottom, but in others, especially where the surface is hard and the lower soil soft and easily handled, the holes need not be so deep, as there is better execution with shallow holes and the labor cost is reduced. The holes are put down along the center line of the ditch and are spaced from eighteen to twenty-four inches apart when only one cartridge is used in each hole. This spacing can be increased if heavier charges, such as two, three or four cartridges are used in each hole. Never attempt to load any considerable length of ditch without first making a few preliminary test shots of from five to ten holes each, in order to determine the best depth of holes, the most economical spacing and the proper number of cartridges to load in each hole. A few tests of this kind will decrease the cost, and enable the blaster to complete a better ditch than would otherwise be possible.

For a small ditch of no great depth a single cartridge of Hercules Straight Nitroglycerin dynamite of 50% or 60% strength is then loaded in the bottom of each hole. No tamping is required if the water rises a few inches over the cartridge. When all holes are thus loaded a second cartridge, primed in the end as illustrated in Fig. No. 21, is placed over the cartridges already loaded in the center of the line, and when all persons are out of danger, the charge is detonated. The shock from this single primer cartridge



BLASTING A DITCH

detonates the adjoining charges, and these charges those next in line, and so on, to both ends of the row of holes. The explosive wave passes through even a long line of holes faster than can be detected by the eye or ear. The loaded soil is lifted into the air and spread over the adjoining field. With such loading of holes, twenty-six to thirty inches in depth, spaced eighteen to twenty inches apart, ditches have been blasted up to three and one-half feet in depth and ten feet top width. Under the varying conditions of the soil the size of such ditch will vary greatly. Larger or deeper ditches may be shot with a single line of deep holes, each loaded with several cartridges of 50% or 60% dynamite.

Sometimes in light material that is very wet, charges smaller than one cartridge may be used, but in such work the loading must be carefully done to insure proper detonation. Where cartridges are cut, the exposed end of the dynamite should be covered with a small cap of mud to prevent it from being exposed to the water. Do not allow the charges to remain in the ground long before firing the shot, and use only Hercules 50% or 60% Straight Nitroglycerin dynamite.

For larger ditches, two, three or four lines of holes may be used. Such additional lines of holes are spaced from three to five feet from and parallel to the first line of holes. These are put down and loaded as has just been described. If a blasting machine is being used for detonating, a fuze should be used in the center hole of each line. If caps and fuse are used, put in one or more additional holes between the two lines and place the primer as is shown in the diagrams on page 49. Always add an extra cartridge to the primed hole.

When large stumps are found in the ditch line, put a few cartridges of dynamite under each, being sure that these are spaced not more than eighteen inches apart and that one of them is near one of the regular holes. No extra loading need be used for small stumps. If boulders are encountered these may be blasted at the same time as the ditch or may be left and blasted later.

## **BLASTING DITCHES WITH A BLASTING MACHINE**

In dry or very hard ground, where the resistance offered by the soil is so great that the explosive wave will not properly detonate holes some distance from the hole containing the primed charge, the electric method, in connection with Hercules E. L. F. Extra dynamite, is used. In this work it is not necessary for the explosive wave



#### A DITCH THAT BROUGHT RESULTS

The above illustration shows the results achieved by dynamite in clearing the channel of Little Allison's Creek in Yorke County, S. C. Little Allison's Creek empties into the Catawba River at the upper end of the pond formed by the power dam of the Southern Power Company, and, owing to the filling up of the pond upstream from the dam, with sand, the flow of the creek had been lessened.

The creek bed proper had become clogged by fallen tree trunks and had filled up until it was slightly higher than the surrounding land and the creek had left the bed and was flowing, in a very shallow but very wide stream, through and over the meadow land which had become practically a swamp.

With a force of nine negroes and with 40% dynamite, using electric blasting, the channel was cleared for a distance of 1,000 feet, between one-thirty and five o'clock in the afternoon of one day.

After the last series of holes were fired, at five o'clock, the creek re-entered its bed and in two days the meadow land was so dry that it could be ridden over on horse-back.

By this ditch 125 acres of very valuable ground were reclaimed, and the cost was about \$40.00. The photograph from which the illustration was made, was taken about one month after the shooting. Crops are now being raised on the land and a serious menace to health has been removed.

to detonate unprimed charges and the holes may be spaced further apart. The holes are put down with a drive point or subsoil bar, and the dynamite loaded at the bottoms of the holes as shown in Fig. 1. A primer cartridge, made with a Hercules No. 6 electric fuze, is used in each hole and should always be at the top of the

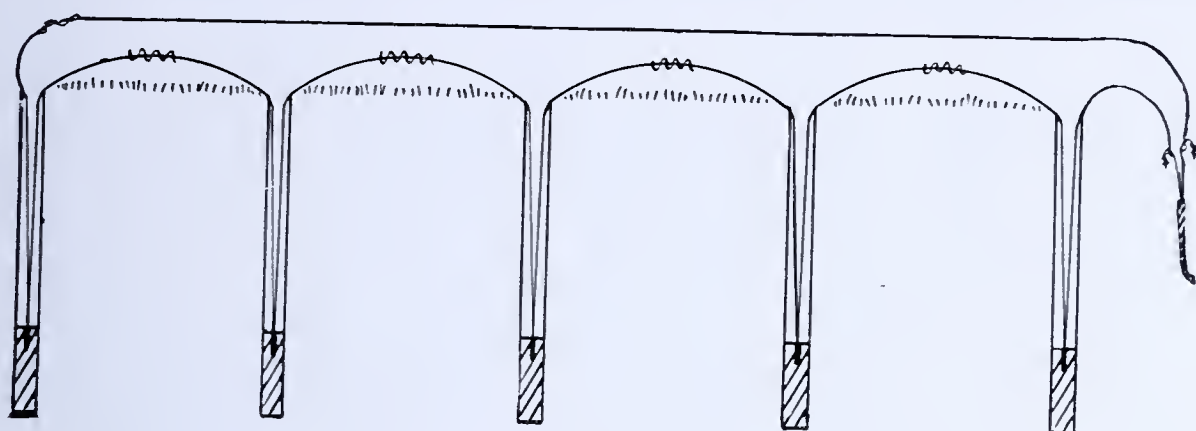
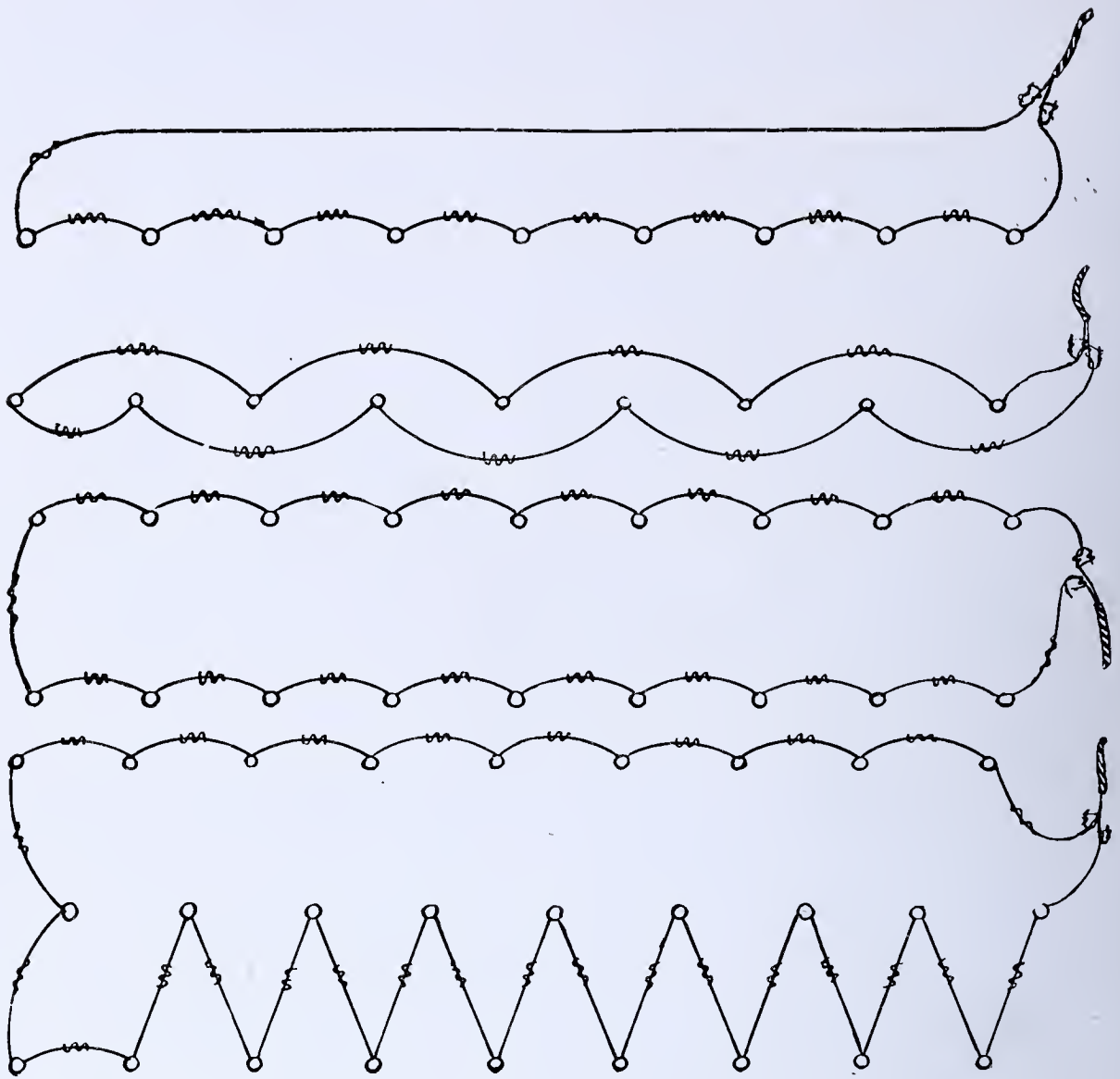


FIG. 1

charge if more than one cartridge is used. As there is no water in such holes to confine the charge, they must all be tamped tight. The number of holes that can be fired at one shot will depend on the size and strength of the blasting machine used. It is best to use one of the larger sizes of blasting machines, as this will permit the shooting of longer sections of ditch. What has been said in the paragraph on "Propagated Blasts," with regard to the variation in the depth and spacing of the holes, applies also to this class of ditching. For light loading in shallow holes the spacing can be materially increased. A few trial shots will give an idea of the depth and of the spacing required. If wide ditches are needed, two or more lines of holes should be used. The method of loading is shown in Fig. 1. The selection of dynamite for this work will vary with the soil and the kind of ditch needed. If narrow ditches in light soil are desired, Hercules E. L. F. Extra dynamite of 25% strength should be used. For large ditches or in hard soil, Hercules E. L. F. Extra dynamite of 40% strength is recommended.

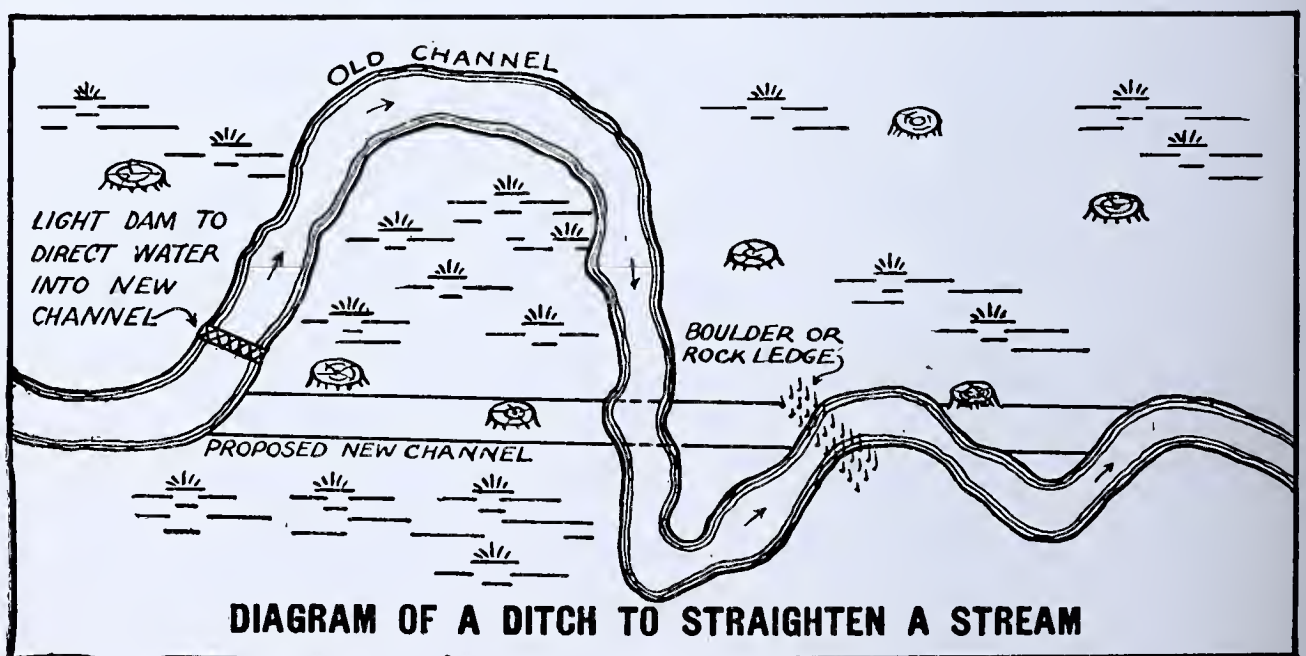
If for any reason (such as cold weather conditions that would prohibit the use of straight nitroglycerin dynamites, or difficulty in securing the proper explosives) it should be desirable to shoot a ditch in wet ground using a United States Standard blasting machine with Hercules E. L. F. Extra dynamite, the primers should be made waterproof by using soap, tallow or a cap of sticky mud over the end of the cartridge where the fuze is inserted. Such shots should be fired as soon as possible after loading, as the "Extra" dynamites are affected by water much more quickly than the straight nitroglycerin dynamites.



VARIOUS METHODS OF CONNECTING UP AN ELECTRIC BLASTING CIRCUIT  
(CIRCLES INDICATE HOLES LOADED WITH FUZES AND DYNAMITE)

## USE OF BLASTED DITCHES IN CONNECTING STREAMS

Many streams are crooked and flow through shallow channels. This retards their rate of flow and causes serious harm to adjacent fields and their crops. Such streams can be straightened, deepened,



and improved by blasted ditches as shown in the diagram on opposite page. In doing this work, the rock ledge, shown in the illustration, must be blasted out to the proper depth and width. Then blast a ditch of the desired depth and width as is shown, being careful to remove all stumps in or near the new ditch. The water



DITCH BLASTED TO STRAIGHTEN A STREAM AFTER ERODING OR "WASHING OUT"

flowing through the old channel is then diverted by means of a small dam.

When such ditches are properly located the rate of flow through them will be very fast and the ditch will constantly be enlarged in size, due to the loosened soil being washed away.

The accompanying illustration shows a ditch that was blasted 15 feet wide. This was for straightening out a bend in a river. In a few months the ditch had washed out and was 60 feet wide.

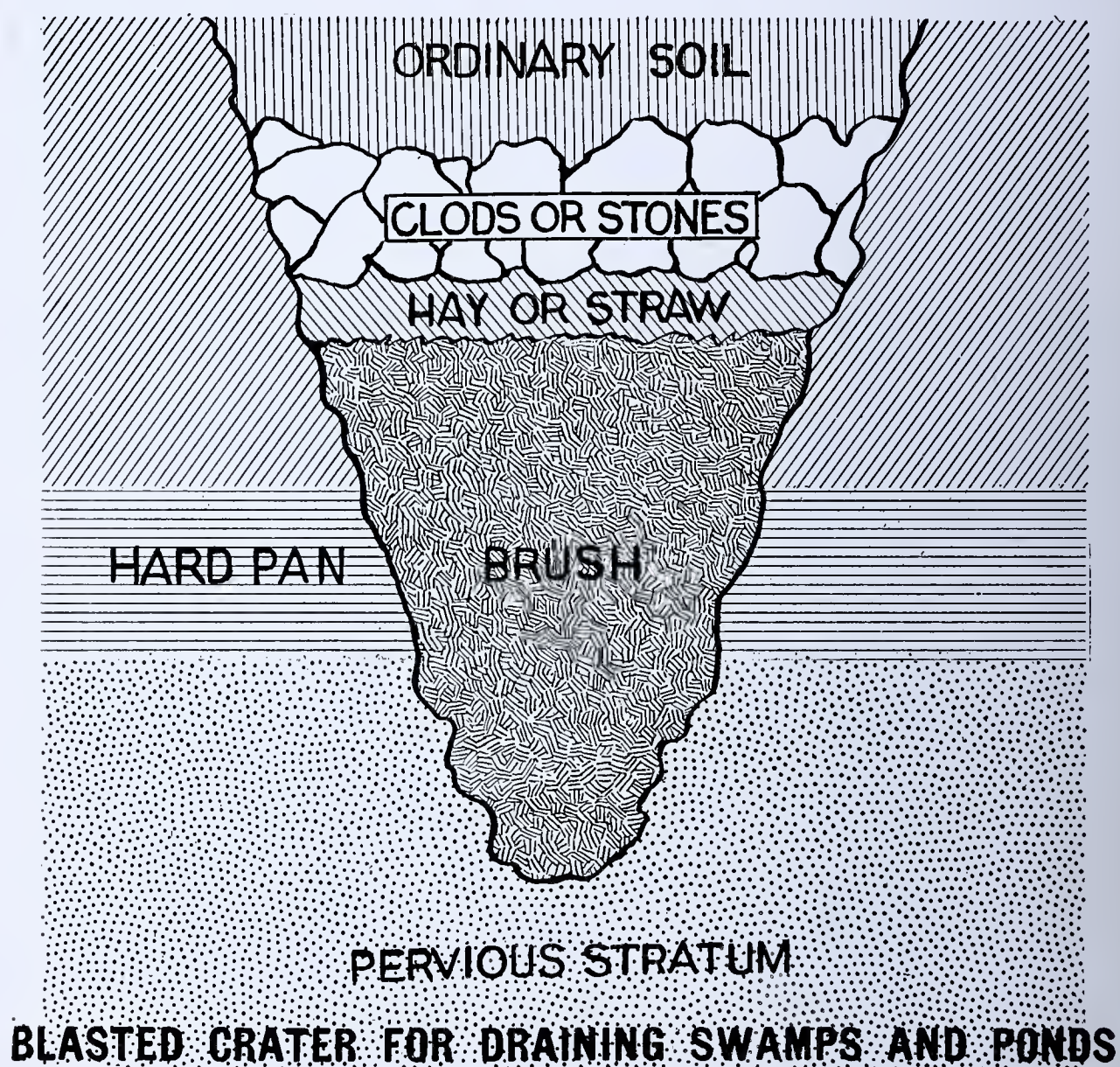
---

## DRAINING SWAMPS AND PONDS

Many small swamps, ponds and wet spots that restrict the crop-producing area of fields, and that are a constant menace to health, are caused by an underlying layer or stratum of hardpan or tight clay, which prevents the water percolating away along natural drainage lines. If a pervious or open stratum is found below this impervious stratum, good drainage can be brought about

by putting down deep holes almost through the hardpan into the pervious stratum and blasting them with a sufficient amount of dynamite to open large cracks into the pervious stratum. Through these cracks the water can drain away. Much valuable land has already been reclaimed by this method.

If the hardpan stratum is of such a nature that it will run together and stop up such a drainage hole, the dynamite charge should be sufficiently heavy to open a decided pit or crater down to the pervious stratum. The bottom of this crater is then filled with brush or other light material to within about two and one-half or three feet of the surface. A layer of straw or waste hay is placed over this and weighted down with small field boulders or hard clods. The surface is leveled over with soil. This filling material acts as a filter and keeps the drainage way open. The accompanying illustration gives a good idea of how such a drainage hole is prepared.



# RECLAMATION OF ALKALI SOILS

The most satisfactory method of removing harmful alkali from field soils is by washing it out through tile or blind drains by heavy irrigation or rainfall. In some cases the hardpan found in such soils is so impervious, that the water loaded with dissolved alkali cannot find its way into the drains. Such a soil should be thoroughly broken up with dynamite before the drains are installed. When a system already installed is not working properly, the condition can be materially relieved by ordinary hardpan blasting, care being taken not to place charges too close to the drains.

When such combinations of hardpan and alkali are underlaid by open material, the use of tile drains can be dispensed with by blasting holes as described for draining ponds and swamps on page 55. If black alkali is found, it should first be reduced to the less harmful white alkali by additions of calcium sulphate before attempting this washing method of reclamation.



HOW CORN GROWS ON LAND THAT HAS BEEN SUBSOILED



DYNAMITE, PROPERLY PLACED, WILL KEEP THE ORCHARD HEALTHY

## **BLASTING HARDPAN OR TIGHT SUBSOILS WITH HERCULES E. L. F. EXTRA DYNAMITE**

Undesirable subsoils are blasted with dynamite to increase their crop-producing power. This may be brought about by:

- Easier percolation of water into the subsoil.
- Easier capillary movement of moisture through the soil.
- Increased storage of moisture.
- Improved development of roots.
- Increased aeration or ventilation of the subsoil.
- Increased action of beneficial bacteria.
- Increased liberation of plant food in the soil.

### **THE IMPORTANCE OF WATER IN CROP PRODUCTION**

Plants require a number of foods and their development is limited by the scarcity of any one of the required foods. Nitrogen, phosphorus, or potassium is added to many soils in manure or chemical fertilizers because they are lacking in one or more of these elements. Water is used in larger amounts than any other plant food, and a scarcity or surplus of water is the most common cause of crop failure. King reports that the amount of water needed to grow a ton of different crops is as follows:

- One ton of barley requires 464 tons of water.
- One ton of oats requires 503 tons of water.
- One ton of corn requires 270 tons of water.
- One ton of clover requires 576 tons of water.
- One ton of peas requires 477 tons of water.
- One ton of potatoes requires 385 tons of water.

All of this must be drawn from the capillary water of the soil, and it is for this reason that the storage of large amounts of capillary water is necessary.

When a soil is water-logged or poorly drained, the pores or openings in the soil are choked with water and root growth is retarded, as will be explained in a later paragraph. It is necessary



LOW SWAMPY LAND CAN BE MADE PROFITABLE BY DRAINING IT WITH DYNAMITE

that such excesses be removed as rapidly as possible by drains so that only the capillary water, which is useful to the plant, is left absorbed in the soil.

## AIR IN THE SOIL

Plants breathe in somewhat the same manner as animals. Little openings are found in the leaves which serve them as nostrils. Roots also need air and will die if deprived of their supply. Plants such as the cypress and other swamp trees make use of "knees" or enlarged stumps, in order to get a supply of air. Field or orchard crops cannot so adapt themselves, and it is necessary to have a sufficient supply of air in the soil for their use. Air is found in the small openings in the soil, but is crowded out when these openings are filled with water.

Air is also needed in the soil to help prepare or digest the mineral foods needed by the plants. Beneficial soil bacteria need air as well as roots and will cease to do their work if they cannot breathe. The nitrogen-collecting bacteria growing on the roots of alfalfa, clover and other leguminous plants also require much air and are killed off by stagnant water in the soil.

Tight clay or hardpan subsoils are poorly aerated, and require correction before reaching anything like a normal crop-producing power. In poorly aerated, water-logged soils some plant foods are converted into forms which cannot be utilized by the plant.

## HARDPAN RESTRICTS DRAINAGE

Hardpan or tight clay subsoils found within normal agricultural depths of soils produce many undesirable conditions that prohibit or materially restrict the power of the soils to produce crops. When the soil receives water, either from rain or irrigation, it is necessary that this sink into the ground in a short time. If there is a stratum or layer of tight material near the surface, the downward movement of the water is retarded to such an extent that much of the water is left on the surface to evaporate. This scalds the crops to such a degree that the yield is reduced, and if the water stands for some time the crop may be killed. Such a condition also retards field work in the spring and after summer rains or irrigation, until the excess water has had time to evaporate. After the water has evaporated from the surface, the soil is usually left hard and breaks up into clods which interfere with cultivation and make it more expensive.

## **CAPILLARY MOVEMENT OF MOISTURE**

Water moves in the soil in all directions, upward, downward and laterally from wet soil toward dry soil, due to capillary pull or attraction. This is illustrated by the little rim of water that rises above the normal water-level in a dry glass or by water rising in a small dry tube, one end of which is in water. This capillary movement is useful in soils in keeping the moisture equally distributed through the mass, in assisting the downward movement of the moisture after a rain or irrigation, and in moving or raising moisture toward plant roots when they have exhausted the supply in their immediate reach. A free capillary movement is therefore very beneficial in all soils. It takes place easily in open soils and is restricted in amount in tight or impervious hardpan or clay.

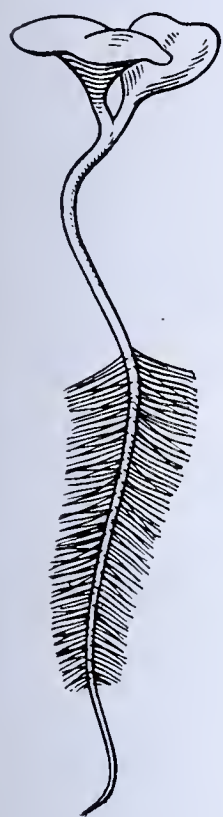
## **CAPILLARY STORAGE OF MOISTURE**

Water is stored or held in the soil in the fine openings or pores between the soil particles, or on the surface of the particles as capillary and hygroscopic moisture. On the amount of water thus stored depends the power of a crop to withstand periods of drought. Ordinarily, a hardpan or tight clay does not hold a large amount of moisture in such a way as to be available for plants, and crops will suffer during periods of drought. Loose, well-granulated soils can hold larger amounts in this way, and can supply a sufficient amount to the roots to keep crops flourishing for a long time after rain. It is very important that both the soil and subsoil be well pulverized in order to store large amounts of moisture.

## **PLANT ROOTS**

The roots of plants serve the double purpose of supporting the above-ground parts of plants and supplying them with food. For the support of large plants, roots should be strong and long enough to be enmeshed in a sufficient amount and depth of earth to insure good anchorage. The depth of soil from which a plant can directly draw its food, including water, is limited by the depth to which the roots penetrate. If the roots are shallow the feeding zone is restricted and plants are likely to grow slowly. If the roots grow deep, the feeding zone is increased according to the depth of growth. It is desirable that plants be deep-rooted, especially when they grow during seasons of drought.

Roots force their way through soils by throwing out tiny rootlets which later grow in size. The rootlets must expend much more energy, and are naturally retarded when forced to work their way through tight material. They grow easily through well pulverized soils and subsoils.



Roots do not take their mineral food in a soil form, but in solution in the soil water. This food-bearing water is absorbed into the roots by tiny root hairs which are shown in the accompanying illustration. These always grow near the ends of rootlets and are not found on the heavy roots. They should always be given a suitable soil in which to grow.

## SOIL BACTERIA

There are both beneficial and harmful bacteria in the soils. The harmful forms thrive best in poorly aerated, water-logged soils, where they decompose organic matter in such a way that the highly valuable nitrogen contained is liberated and lost as gas, instead of being converted into nitrates that can be used by plants. The beneficial forms do not thrive under such conditions, but are plentiful in the well-aerated soils where they decompose roots, manure and other forms of organic matter into humus without losing the nitrogen contained in them. They are also busy breaking down the tiny particles of clay and sand, so that the insoluble plant food contained in these particles is rendered soluble and suitable for feeding the rootlets.

## PLANT FOOD

The mineral plant foods, to be available for plants, must be in such a form that they are easily soluble in water. In the soil particles these valuable elements are usually found in some form or combination, that is too slowly soluble to afford sufficient amounts for the production of satisfactory crops. These compounds are broken down and the foods they contain liberated by the action of the water, air and beneficial bacteria of the soil, but are left with little or no chance in tight or hardpan soils. All fields should be so managed as to give each of these agencies the best possible chance to work.



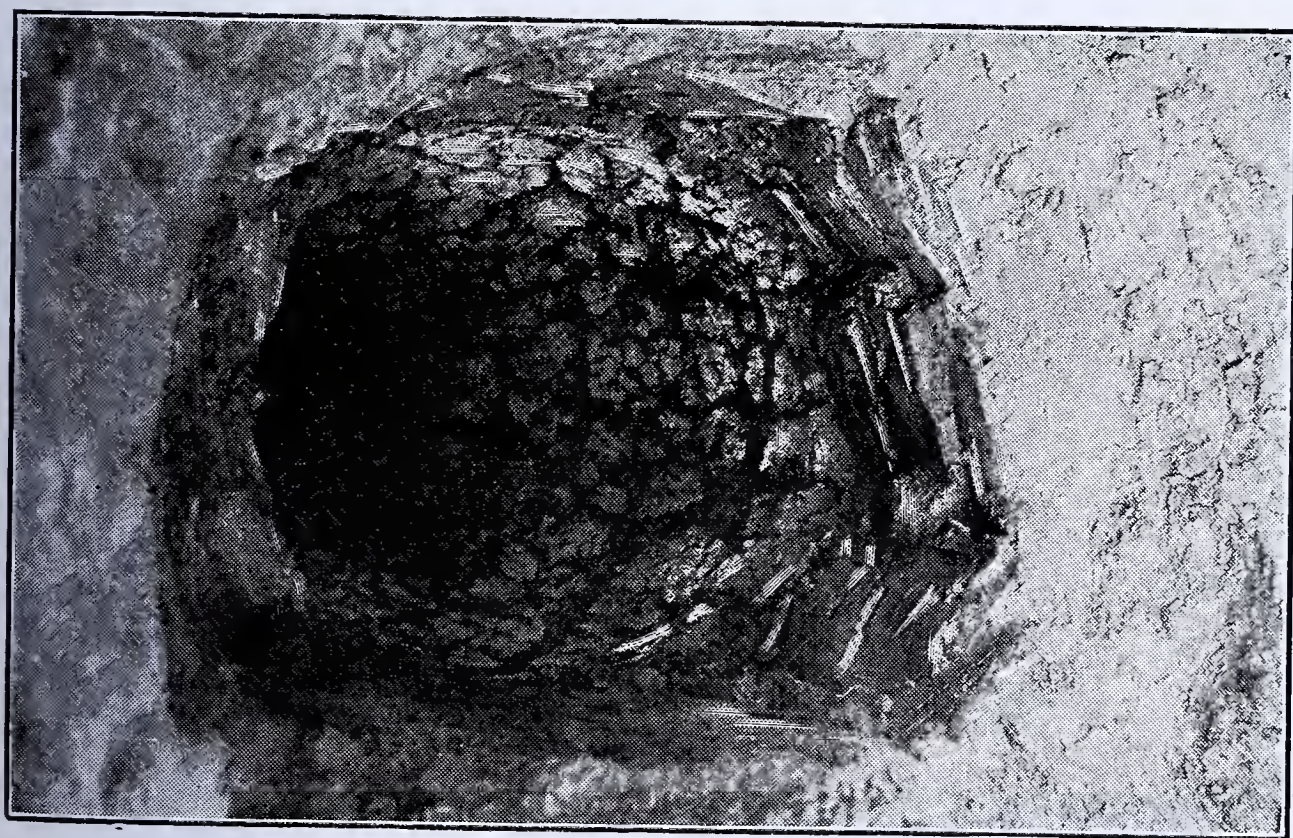
SUBSOILING FREES THE MAXIMUM AMOUNT OF PLANT FOOD AND INSURES GOOD CROPS

## THE RELIEF OF SOME UNDESIRABLE SOIL CONDITIONS

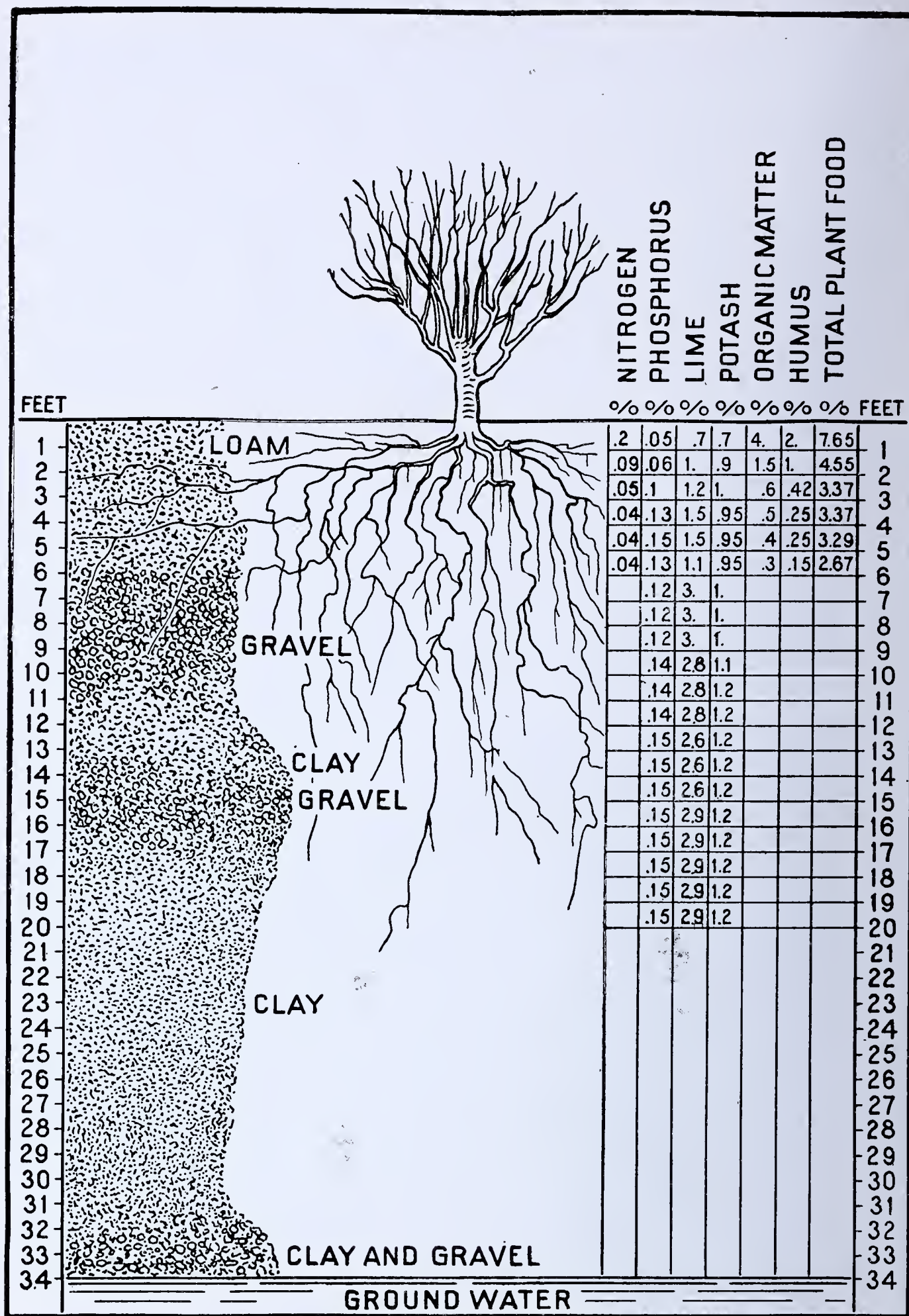
Shattering hardpan or tight clay subsoils with Hercules dynamite has proved a wonderful means of correction. When hardpan material, which prevents the downward movement of moisture is blasted, cracks or fissures, through which the water can descend, are opened and permit the draining away of excesses of water which cause harm when held on the surface.

The capillary movement of moisture is more pronounced and beneficial in soils that are loose than in tight or hardpan soils, and can be materially increased in its action by thorough blasting. When this action is unhampered, it assists first in carrying water down into the subsoil and later in lifting it back into the feeding zone of the roots.

Attention has been called to the poor water-storing capacity, the limited aeration, the undesirable conditions for bacteria and the poor conditions for the preparation of plant food in hardpan and other tight or impervious soils. Such conditions are relieved by well-placed Hercules dynamite blasts.



HOLE BLASTED FOR TREE PLANTING. CONTRAST THIS WITH A SPADE DUG HOLE THAT HAS HARD, SMOOTH SIDES DIFFICULT FOR THE ROOTS TO PENETRATE



Soil section showing downward growth of roots to 21 feet, and percentages of various plant foods at different depths. As the drawing and tables were obtained from different sources, the percentages do not indicate those in the soil in the drawing, but are composite percentages from analyses of different soils.

# THE USE OF HERCULES E. L. F. DYNAMITE FOR SUBSOIL BLASTING

In blasting for the relief of the undesirable soil conditions just described, Hercules E. L. F. Extra dynamite of 25% or 30% strength is used. Ordinarily, the bore holes for such blasting are put down from fifteen to twenty feet apart, the spacing depending upon the hardness of the soil. Where the surface soil grades off into tight subsoil of great depth, the holes should be from thirty to thirty-six inches deep. If the hardpan or tight clay stratum is found close enough to the surface to prevent deep rooting of plants and is underlaid by looser material, the blast should be placed in the hardpan and not above or below it. This will at times necessitate very shallow loading and at other times loading much deeper than three feet. For locating a thin stratum of hardpan, careful examination of the soil should be made before loading and the blasted holes should be examined occasionally as the work progresses to see if the charges are properly located. As such hardpan will vary in depth in different parts of the field, it is necessary to make a number of test holes. Ordinarily, the position of hardpan can be located with a soil auger, but in some sandy hardpan material that bores easily, it will be better to dig out a few blasted holes and make a close examination of the location of the hardpan.

The amount of dynamite ordinarily used for a charge is one-half of a 1 1/4 x 8-inch cartridge (one-quarter pound), but for tight soils that do not shatter well, the load should be increased. Estimating the amount of dynamite per hole as above, we find that the following amount of dynamite and supplies will be needed in blasting an acre of soil with holes spaced at different distances apart.

**TABLE SHOWING AMOUNT OF DYNAMITE, CAPS AND FUSE REQUIRED TO BLAST ONE ACRE**

Distance Apart of Holes in Feet	Number of Holes per Acre	Pounds of Dynamite per Acre	Number of Caps per Acre	Amount of Fuse per Acre, using 2 1/2 Ft. per Hole
15	196	49	196	490
16 1/2 (1 Rod)	160	40	160	400
20	49	13	49	122
40	25	7	25	63



MAKING "PRIMERS" FOR SUBSOILING

If deeper holes or heavy loading are used, increase the amount of fuse and dynamite accordingly. The cost of dynamite and other supplies can then be easily estimated on the local price.

For putting down subsoil holes, use a subsoil bar and sledge as described in the chapter on "Tools," page 29. Load and tamp as advised on page 25.

## **BENEFITS DERIVED FROM SUBSOIL BLASTING**

A large number of tests conducted in different parts of the United States have demonstrated fully the benefits to be derived from subsoil blasting. On tight clay subsoil, where the trouble from surface water was bad, such blasting increased the yield from nothing to 40 bushels of oats per acre. On another hardpan subsoil the yield of oats was increased from 25 to 40 bushels per acre. Tests with alfalfa showed an increase of from 20% to 40%; with corn and other field crops the increase has been about the same; with cotton more than 200%.

Tests that have continued over several years indicate that the increases in crop yield, due to subsoil blasting, are more marked in the second and third years than in the first.

## CAUTIONS TO BE OBSERVED IN SUBSOIL BLASTING

Blast subsoils when they are dry. When subsoils are wet, the action of the explosives may be to spring a cavity or pot hole, and to compact the subsoil rather than to loosen it. It is best to do all subsoil blasting far enough in advance of seeding time to allow the soil immediately around the blast to be settled a little by the rain. Before using teams on blasted fields, examine all holes and see that there are no cavities left into which a horse might step and be lamed.



TOMATOES GROWN ON LAND THAT HAS BEEN SUBSOILED

# TREE PLANTING WITH HERCULES E. L. F. DYNAMITE

Tree roots grow as do the roots of other plants, and should be hastened in their early growth by having good soil conditions in which to develop. No other practical means prepare such satisfactory holes for tree planting as does blasting. Holes made in this manner leave the subsoil shattered and capable of storing more water than would otherwise be possible. The roots are given a more open material through which they can send down their feeders; in fact, all the benefits derived from subsoil blasting for crops apply to tree planting.

For blasting holes for tree planting, proceed exactly as in subsoiling. Put down the holes with special reference to the hardpan



THIS TREE AND THE ONE ON PAGE 71 ARE EACH NINE YEARS OLD.  
THEY ARE IN THE SAME ORCHARD, NOT 200 FEET APART.  
THIS ONE WAS PLANTED IN A SPADE-DUG HOLE

and load according to its hardness, increasing the load for very hard material. Do not feel disappointed if the blast fails to make a hole, for many of the best shots leave the surface practically



THIS TREE WAS PLANTED IN A HOLE MADE WITH DYNAMITE AT THE SAME TIME AND IN THE SAME SOIL AS THE ONE ON PAGE 70

undisturbed, the force of the explosive being expended in shattering the subsoil. When holes are blasted in this manner, remove a few shovelfuls of the loosened soil to admit the roots. In setting a tree in a blasted hole, tamp the earth well around the roots and leave three or four inches of loose soil at the surface to act as a mulch. It is well to allow at least one rain to fall in blasted holes before setting the trees, as this will settle any excessive disturbances of the soils

immediately around the blast before the planting of the trees.

Holes can be blasted in the fall for spring planting. In planting trees in freshly blasted holes, always examine the holes with a stick and fill up any pot holes or cavities that may have been formed by the blast. If this is not done, subsequent settling of the soil may carry the trees to too great a depth in the ground. For estimating the amount of dynamite required for blasting holes for planting trees, see the table of amounts on page 67. If trees are to be set in suitable holes, and not in mere pockets shoveled out for their roots, blasting is much more economical than digging holes by other means.

## BENEFITS DERIVED FROM BLASTING HOLES FOR PLANTING TREES

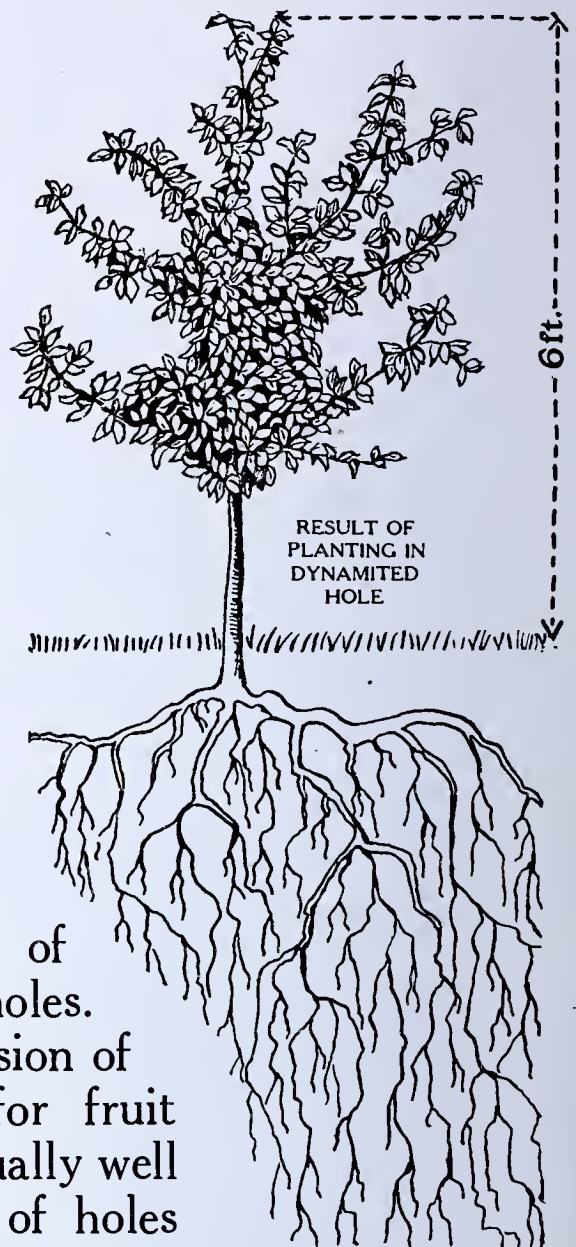
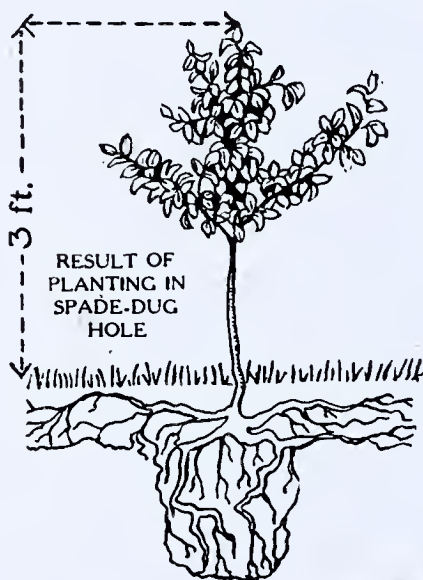
Work of this nature has extended over a period of more than twenty years, and old orchards are frequently located that were planted in this manner fifteen or more years ago. Among the earlier tests of this nature was one in a California orange grove where a part of the trees were planted in spade-dug holes and the remainder in holes blasted with dynamite. The results were that the trees set in the blasted holes developed better and were alive and bearing fruit after the others were dead. Similar tests made in the past with apple and other fruit trees confirm this finding. More recent tests have shown that when trees are carefully set in blasted holes, the loss from death in the first years, when there is usually a great loss, is reduced to a minimum, and in several tests there

have been no first year losses of trees in blasted holes.

This discussion of blasted holes for fruit trees applies equally well to the blasting of holes for setting shade trees, decorative plants and ornamental hedges. Where the subsoils are at all tight, no fruit or ornamental trees, shrubs or flowering plants should be set without first thoroughly

cultivating the subsoil to a considerable depth by the use of Hercules dynamite.

The two illustrations shown above give a very good idea of what happens to a young tree planted in a spade dug hole, and the advantage given to a tree of the same age planted in a dynamited hole. The extra growth and spread of roots of the latter are not exaggerated.



## REJUVENATION OF ORCHARDS

Many orchards, both young and old show the harmful effects of underlying hardpan. This causes poor fruiting and growth, as well as early dying, thereby reducing the profits derived from the orchards. When such conditions are found in either young or old orchards, much good can be accomplished by deep tillage with Hercules dynamite. For work of this nature, modify the ordinary methods of hardpan blasting to suit the needs of the trees. When young trees are cultivated, put down holes as advised for subsoiling among the ends of the lateral roots. The distance from the trees will depend on the age of the trees and the vigor of the root development, but should not be closer than eight feet from the trees. For such work it is sometimes advisable, when the hardpan is very tenacious, to blast four or more holes in a circle around the tree, but it will be better to blast on only two sides the first year and on the remaining two sides a year or so later.

For cultivating old orchards where the roots have spread over the entire area, place all holes in the centers in the squares formed by the trees, or midway between the trees in the lines in both directions. Load and fire as has already been described.

Such blasting should be done when the trees are dormant or when they are least active in growth. Pruning the branches, if any is needed, should be done before the next season of growth. If the blasting has been of such a nature as to break many feeding roots, the tops should always be pruned in order to reduce the growth of above-ground parts to correspond with the temporary decrease in the activities of the feeding roots. This decrease in the feeding power of the roots will be of very short duration, as new feeding roots will be thrown out in the loosened soil, and will be able to obtain much more food than was possible before the blasting was done.

When orchards are in need of fertilization, it is an excellent practice to put the holes down deeper and load heavy enough to blow out a crater. This is filled with alternate layers of soil and well-rotted manure. If manure is scarce, use loamy soil and high grade fertilizers.

# OTHER USES OF HERCULES DYNAMITE ON THE FARM

---

## ROAD BUILDING

The cost of road grading and ditching can be very materially reduced by using Hercules E. L. F. dynamite.

In making cuts through tight clay or shale the cost of excavating can be very materially reduced by loosening the clay or shale with Hercules dynamite. For such work holes are put down from the surface to a point slightly below the grade of a desired cut. As a general rule these holes should be spaced about six feet apart each way and loaded with two or more cartridges of Hercules E. L. F. dynamite of 40% strength. The burdens\* and the spaces between the holes should always be a little less than their depth. While such a series of shots may be fired with caps and fuse, better execution will be had by firing a number of holes at the same time with Hercules electric fuzes and a United States Standard blasting machine. Such a blast will not only shatter the clay or shale so that it may be handled easily by shovels or scrapers, but will also throw much of it out of the cut, so that it will not require re-handling.

In cutting through solid rock, it is best to begin at the end of the cut at the desired grade and remove the rock in vertical benches rather than in layers, as is the practice in cutting through earth when scrapers are used. For cuts less than six feet in depth, start back on the rock a distance equal to the depth of the cut and drill holes down to one foot below the grade. These holes should form a line across the cut and should be spaced a distance apart equal to the distance they are back from the face. For holes deeper than six feet, go back six feet on the rock and space the holes six feet apart. The dynamite recommended for this work is Hercules E. L. F. Extra of 40% strength. All holes should be loaded slightly more than half full of dynamite and must be securely tamped. It is more economical and better execution is obtained if such a line of holes is fired with a blasting machine.

---

\* "Burden" is the distance from the face of the cut to the line of holes. As the face may be sloping, the "top burden" equals the distance from the top of the face of the cut to the line of holes, and the "bottom burden" the distance from the bottom face of the cut to the line of holes, each measurement being made horizontally.

For removing stumps and boulders, use the Hercules explosives and methods of loading already described.

Road ditching is done in the same manner as other ditching. Use "propagated blasts" where possible, but electric blasts in dry ground.

## **EXCAVATING FOR CELLARS, FOUNDATIONS, ETC.**

When blasting to reduce the effort of digging clay or shale in excavating cellars, underground ice houses, or other large holes, the earth may be blasted as in road cutting through rock or through clay. If there is danger of loosening the earth on which a building is to stand, do not load the holes very heavily. In such a case it will be better to cut one part down to grade and blast the remainder in benches as is described in cutting roads through solid rock.

Hercules dynamite is also useful in clearing away unsightly banks or terraces or for leveling the sites for all classes of buildings.

## **DIGGING WELLS**

In digging open wells, rock too hard to be handled with pick and shovel is often found and must be blasted. For this work locate the center of the well and move away from this point about ten inches and drill a hole down at an angle of about 60° pointed toward the center. Three or four additional holes are then put down around the center, spaced the same distance apart and pointed toward the center. These should be from three to four feet deep and should be about six to eight inches apart at the bottom. Load each of these with two or three cartridges of Hercules Gelatin E. L. F. of 40% strength and tamp well. When using caps and fuse to detonate the charges be sure to cut the fuse long enough to allow the workman to be drawn out of the well and to retire to a safe distance. When buildings are a sufficient distance from the well to prevent damage from heavy blasts, the entire circle of holes should be fired at one time with a Hercules blasting machine, using No. 6 Hercules electric fuzes. This blast is called a "cut shot" and should leave a cone-shaped depression in the bottom of the well.

To open the well to the desired diameter, a second set of holes is drilled as near the side wall as possible. These should be placed about two feet apart and should be driven to the same depth as the holes for the cut-shot. They will require about the same loading and should be detonated in the same manner as the cut shot.

To lessen the danger from such a blast, heavy timber or logs should be laid across the top of the well if buildings are very close. The fumes given off from a dynamite blast are very obnoxious, and the workmen should not return to the well until after a considerable time has elapsed and the fumes have passed up out of the well. Hercules Gelatin is waterproof, gives off the smallest amount of bad fumes and therefore should be used for well sinking. When possible, shoot just before quitting for noon or at night.

## **SPLITTING LOGS**

Many logs are too large and heavy to be handled easily or economically without first splitting them. Hercules blasting powder of FFF granulation is advised for this work. It is loaded into auger holes bored in the log in a straight line down the side. The desired load is poured into the hole and a sufficient length of safety fuse inserted, so that its lower end is an inch or more in the powder. Tamp first with dry paper and later with moist clay that can be packed into a tight plug.

For large logs of valuable timber it is better to bore a row of holes, spaced from four to six feet apart, well into the center of the log and load as just described, substituting an electric squib for the fuse. Such a shot is fired with a blasting machine and if properly placed will split the log into two or more sections without excessive shattering or splintering.

## **GULLY FILLING**

In many places it is necessary to fill up gullies, old stream beds or holes. This work can be materially cheapened and hastened by blasting instead of depending entirely on plow and scraper work, especially if the gullies are deep or the earth very hard. The proper procedure is to go back from the edge of the gully about five feet and put down holes spaced from four to five feet apart to the desired depth. Load these about half full of unbroken cartridges of Hercules E. L. F. Extra dynamite of 25% strength. Tamp well and fire the entire line at one blast with a Hercules blasting machine. If no blasting machine is available, good work can be done by detonating with caps and fuse.

## **CONTROLLING EROSION**

When hills or sloping fields are being damaged by erosion caused by the rain water not being able to percolate into the soils, much benefit can be derived by blasting as in ordinary subsoil work,

taking care not to make straight lines of holes up and down the hill. It is well, also, to place blasts a few feet away from the little gullies that have been washed, and leave these to be filled with the plow after better percolation has been established by blasting.

## DIGGING HOLES FOR POLES AND POSTS

Much time and labor can be saved by using Hercules dynamite in digging post holes. Only enough explosive should be used to make the digging easy; larger charges loosen up the ground to such an extent that it is difficult to make the poles or posts as firm as they should be. This applies particularly to large poles.

The best way to do this blasting is to drive a crowbar down into the ground within six inches of the desired depth of the hole. In the bottom of this hole explode from one-quarter to one  $1\frac{1}{4}$  x 8-inch cartridge of Hercules E. L. F. 40% Extra dynamite. *Do not tamp* as this would cause the explosive to loosen the ground too much. When digging holes for large poles, the loosening of the ground can be confined to the proper area by digging a square hole, a little larger than the post, to a depth of about eighteen inches before blasting.



## **GENERAL RULES WITH REGARD TO THE HANDLING OF EXPLOSIVES**

Always handle boxes of explosives or detonators and loose dynamite or detonators carefully, and keep them stored in a dry place, out of reach of animals or irresponsible persons. Do not store explosives and detonators in the same building.

Open all boxes of explosives or detonators with a wooden wedge as though you desired to save both box and lid intact.

When dynamite is frozen, thaw it only as described in this book, as many other methods are dangerous.

Never allow dynamite to remain in wet bore holes for any length of time. Load and fire as quickly as possible.

Always cut safety fuse long enough to reach three or four inches out of the bore hole, and when large blasts are likely to throw fragments of stone or wood to a considerable distance, allow a greater length of fuse so that the blaster can retire to a safe distance.

Always prime cartridges as illustrated on pages 22 and 24.

Do not handle primed cartridges carelessly, and always carry them in your hand or in a wooden vessel.

Use only a wooden tamping stick for loading and tamping and do not tamp hard on the primed cartridge. After a few inches of loose tamping cover the primer, tamp as hard as you can, using the tamping stick in one hand.

Never fire a shot until all persons and animals are out of danger from flying material. Keep dynamite and detonators well away from the blast.

Never smoke while handling explosives or detonators and keep both well away from fire.

Always handle detonators with the greatest care and do not carry them loose in your pocket.

We Manufacture and Market

# EXPLOSIVES

of every kind and for all purposes

---

Metal Mining	Coal Mining	Quarrying
Submarine Blasting	Railroad Construction	
Stump and Boulder Blasting		
Ditching	Draining	Subsoiling
Tree Planting, Etc., Etc.		

We guarantee not only the  
Quality of our Goods, but also  
Prompt and Efficient Service  
and careful attention to every  
Inquiry and Order.

We also carry a full line of Blasting Supplies and all  
tools required for "Progressive Cultivation"

## ***HERCULES POWDER CO.***

Wilmington, Delaware, U. S. A.

---

### BRANCH OFFICES:

CHICAGO  
HAZLETON

PITTSBURG, KANSAS  
PITTSBURGH, PENNA.

SALT LAKE CITY, UTAH  
SAN FRANCISCO, CAL.

# Hercules Sporting Powders

(Black and Smokeless)

For

**Shotguns, Rifles, Revolvers  
and Pistols**

---

## **Black Sporting Powder**

L. & R. ORANGE EXTRA SPORTING

“Standard since Eighteen-eight”

## **Smokeless Shotgun Powders**

“E. C.”—A “bulk” Smokeless Powder

“An Old Name, but a New Powder”

“INFALLIBLE”—A “dense” Smokeless Powder

“The Best All-round Shotgun Powder ever made”

## **Smokeless Rifle Powders**

LIGHTNING

SHARPSHOOTER

W.-A. 30 CALIBRE

UNIQUE

## **Smokeless Revolver and Pistol Powder**

BULLSEYE

*Write us, or our nearest Branch Office (see Back Cover) for  
Leaflets describing any one or all of the above powders.*

***HERCULES POWDER CO.***

Wilmington, Delaware, U. S. A.



# ***HERCULES POWDER CO***

Manufacturers of

## **EXPLOSIVES**

For All Kinds of

## **WORK ON THE FARM**

---

We guarantee not only the  
Quality of our Goods, but also  
Prompt and Efficient Service  
and careful attention to every  
Inquiry and Order.

---

HOME OFFICE

**Wilmington, Delaware, U. S. A.**

---

BRANCH OFFICES

Chicago, Ill.

Pittsburg, Kan.

Salt Lake City, Utah

Hazleton, Pa.

Pittsburgh, Pa.

San Francisco, Cal.